

# iMac (Retina 5K, 27-inch, 2020) Overview

## Scope of this Document

[iMac \(Retina 5K, 27-inch, 2020\) Service Guide](#) provides troubleshooting steps, repair procedures, and other information for this iMac model only. Separate service guides cover other iMac models.

## Overview Contents:

- [Features](#)
- [Service Considerations](#)
- [New Tools](#)
- [Serial Number Location](#)
- [Diagnostic Software](#)
- [Recovering a Lost Firmware Password](#)
- [Reinstalling Software That Came With The Computer](#)



## Features

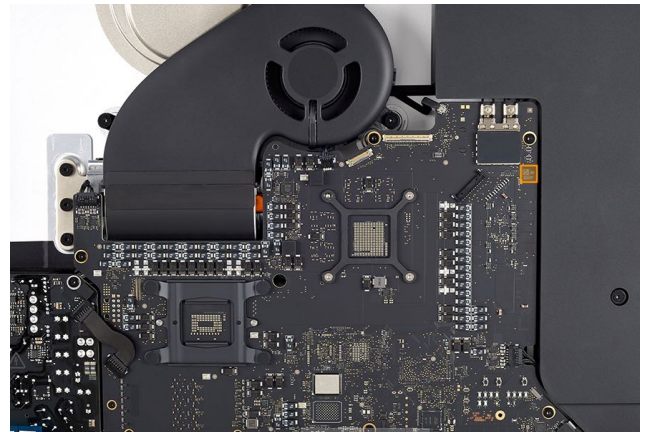
- Display: standard or nano-texture glass
- Processors: 3.1GHz 6-core Intel Core i5, configurable to 3.7GHz 10-core Intel Core i9
- Graphics: Radeon Pro 5300 with 4GB of GDDR6 memory, configurable to Radeon Pro 5700 XT with 16GB of GDDR6 memory
- Storage: 256GB, 512GB, 1TB, 2TB, 4TB, 8TB  
**Important:** The flash storage is paired to the logic board and encrypted by the Apple T2 Security Chip. The flash storage is not removable. Refer to the service considerations below for additional details.
- Memory: 8GB GDDR4, configurable to 128GB
- I/O Ports:
  - SDXC card slot
  - Four USB 3 ports
  - Two Thunderbolt 3 (USB-C) ports
  - 10/100/1000BASE-T Gigabit Ethernet (RJ-45 connector) configurable to 10Gb Ethernet
- [Tech Specs](#)

## Service Considerations

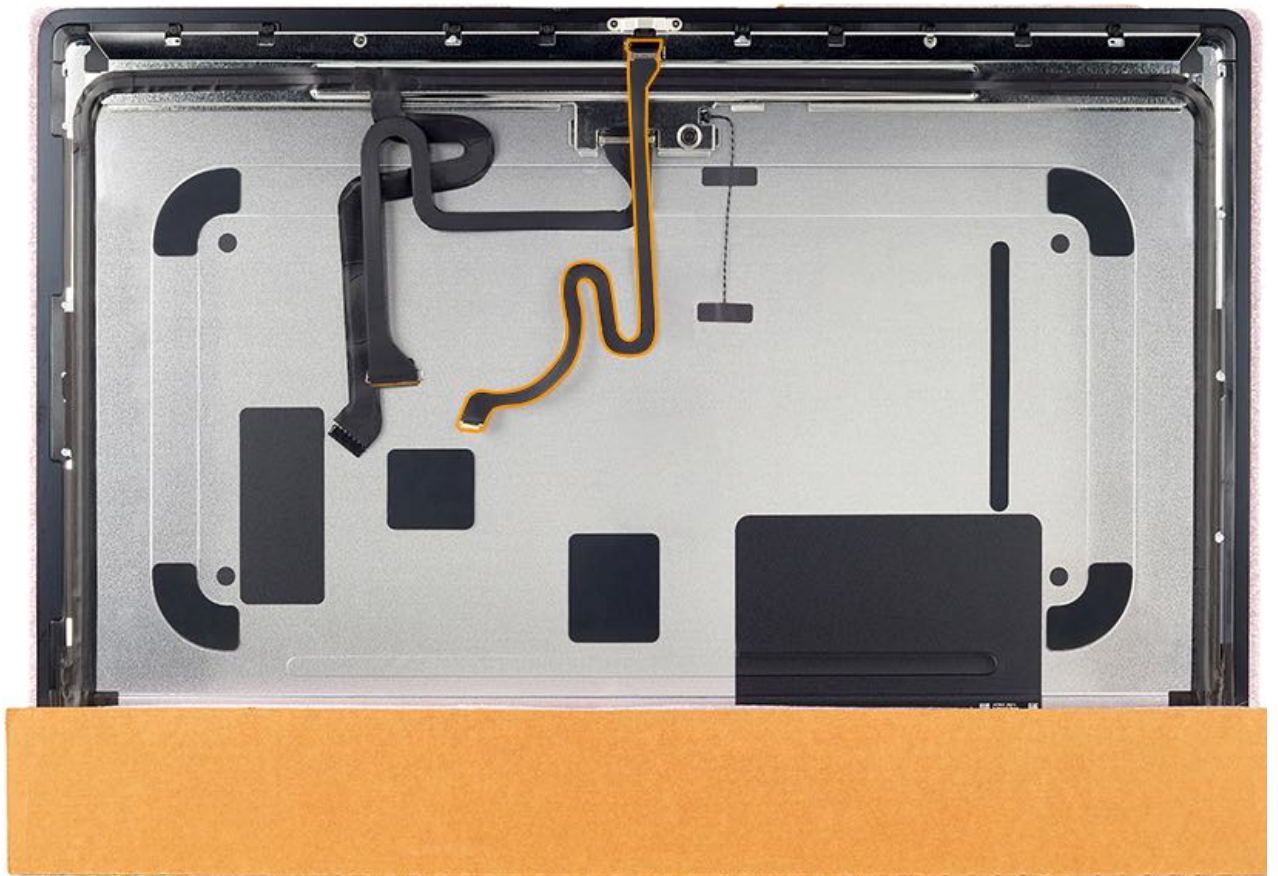
- iMac (Retina 5K, 27-inch, 2020) can be configured with a nano-texture glass display. The nano-texture glass has a unique surface and [requires special care when cleaning](#) (HT210229). Follow the special care instructions, use only the Apple polishing cloth (923-04724), and wear lint-free gloves (922-8253) when handling the display.



- You must run [System Configuration](#) (TP1657) when you replace the [display](#) (RP1656) or [logic board](#) (RP1654). Scan the 2D barcode on the original part and the replacement part.



- The flash storage is integrated with the logic board and encrypted by the Apple T2 Security Chip. The 4TB and 8TB storage configurations of the logic board include a flash storage connector with flash storage card. The flash storage is paired with the integrated storage on the logic board and also encrypted by the Apple T2 Security Chip. Don't remove the flash storage card when replacing the logic board. Data cannot be accessed or recovered if installed in another logic board. Make sure the customer has a working backup of their data before removing or replacing the logic board. Refer to the following articles for additional information:
  - [Data Transfer for Mac Computers with the Apple T2 Security Chip](#) (TP1658)
  - [Back up your Mac with Time Machine](#) (HT201250)
- The camera is integrated with the display. The camera cable needs to be disconnected from the logic board during [display removal](#) (RP1655).

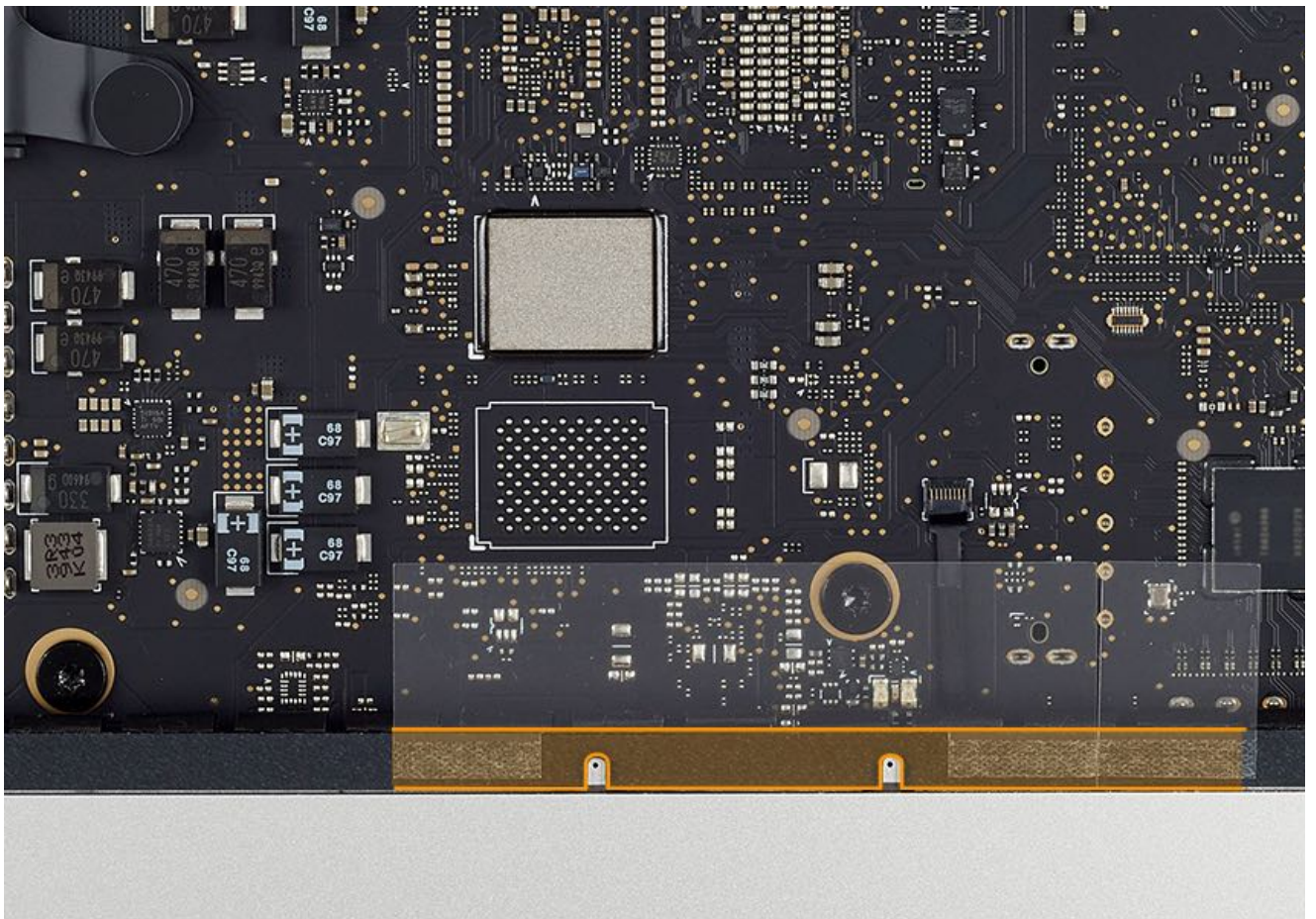


- The coin cell battery on the iMac (Retina 5K, 27-inch, 2020) logic board is positioned vertically near the integrated wireless card. Use extra care when inserting and removing the wireless support tool.

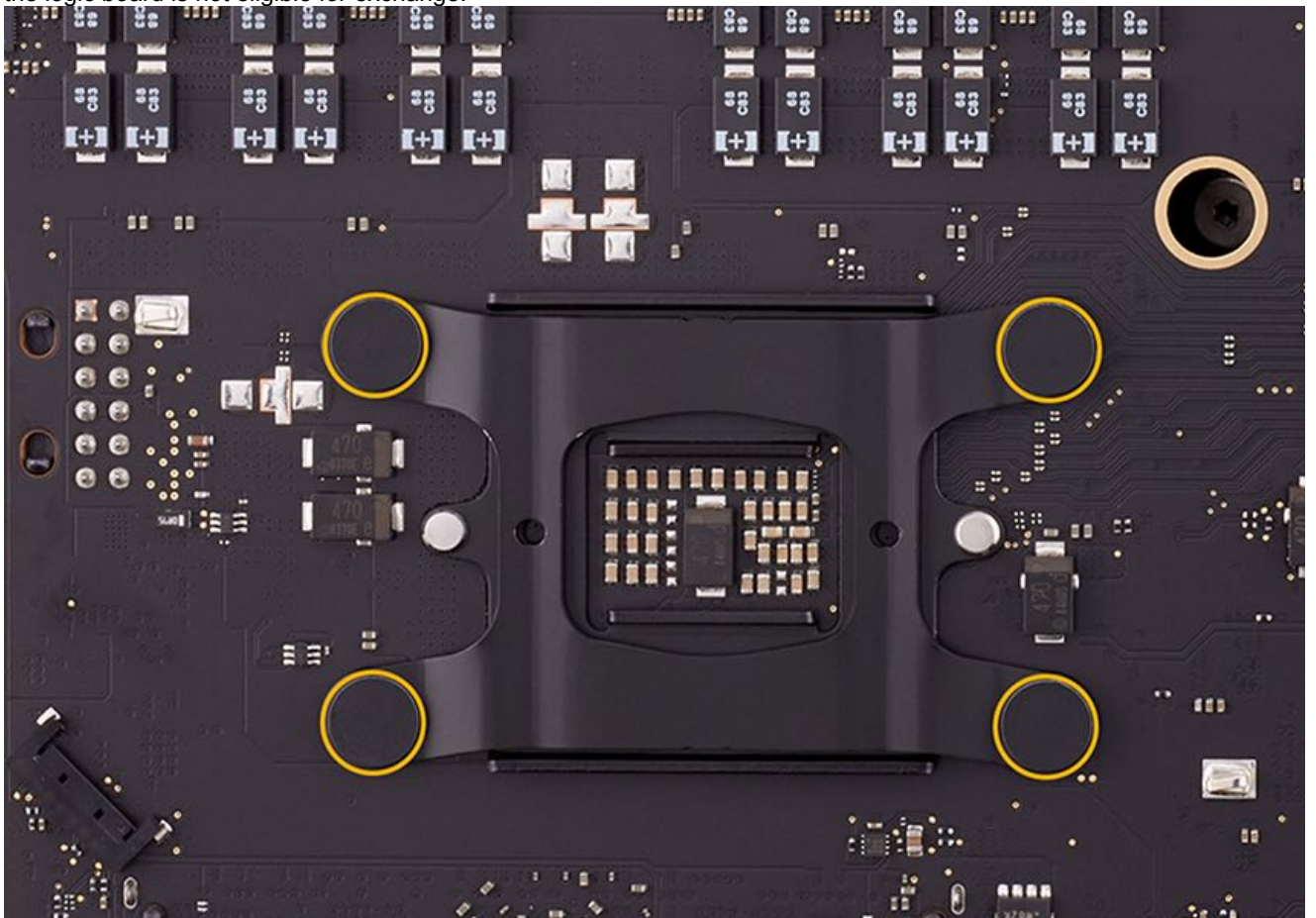


- Dual chin microphones are located on the rear housing. Use the correct display adhesive strips and verify that the microphone holes are not blocked before you reinstall the display.





- Verify that the tamper indicator labels on the heat sink are intact. If labels have been removed or tampered with, then the logic board is not eligible for exchange.



- Some of the procedures are shared between iMac (Retina 4K, 21.5-inch, 2019), iMac (Retina 5K, 27-inch, 2019), and iMac (Retina 5K, 27-inch, 2020). Images in these shared procedures may show one model but the steps to perform the repair are the same for all unless otherwise noted.





- NetBoot is not available for these models.

### New Tools

- Display adhesive—very high bond (VHB)—strips
  - 076-00490, starter kit
  - 076-00491, refill kit
- Apple polishing cloth for nano-texture displays
  - 923-04724

### Serial Number Location

The serial number is located on the bottom of the stand.

**Note:** If the computer has a VESA mount, then the serial number is located on the underside of the VESA mount tongue.



### Diagnostic Software - Apple Service Toolkit 2 (AST 2)

AST 2 is a cloud-based diagnostic system to help technicians triage and verify repairs for Mac computers. With AST 2, technicians are able to initiate diagnostics wirelessly on a user's device using Diagnostic Console (a web application on a Mac or iPad). Technicians are also able to view diagnostic results in Diagnostic Console.

### **Recovering a Lost Firmware Password**

Only technicians at Apple Stores or Apple Authorized Service Providers can unlock these iMac models when they are protected by a firmware password.

### **Reinstalling Software That Came With The Computer**

This procedure requires an Internet connection.

**Note:** In some situations, a user may have set a firmware password. The user must know the firmware password in order to reinstall macOS.

**Caution:** Apple recommends that users back up their data before any software restore procedure. Back up essential files before installing macOS. Apple is not responsible for any loss of data.



# Data Transfer for Mac Computers with the Apple T2 Security Chip

Mac computers with the Apple T2 Security Chip have security features that require a specific [data transfer process](#) (SV373). You may be able to transfer data from a damaged logic board before you service it.

## Important:

- This data transfer procedure is only for transferring data from a Mac computer with an Apple T2 Security Chip to an external hard drive.
- If the logic board or flash storage on the user's computer isn't damaged, you can [move content directly from the user's computer to another Mac computer with an Apple T2 Security Chip](#) (HT204350).
- If you replaced the logic board or flash storage on the user's computer, ensure the data is backed up. You can't recover data after running System Configuration.
- The user's computer is unresponsive during the data transfer.  
**Note:** After you complete a logic board or flash storage repair and run System Configuration, the user's computer is responsive. If you have not done a repair, [restore firmware in Apple Configurator 2](#).
- You can't modify files and folders from the volumes on the user's computer. Volumes on the user's computer are read only.  
**Caution:** After the transfer process, some files such as .bin, .etc, .tmp, and .usr may be visible on the external hard drive. This is normal. Don't delete or modify these files or folders or you may cause issues for the customer when they migrate information from the external hard drive back to the user's computer.
- The external hard drive takes 10–20 minutes to be partitioned.
- Data is transferred at USB 2.0 speed. The time it takes to complete the data transfer depends on how much data is on the user's computer, and could take up to four days.
- When the data transfer is complete, return the external hard drive with the user's data to the user. If the data successfully transferred, tell the user how to [use migration assistant to migrate their data back to their computer](#) (HT204350).

## Tools:

- Power cord
- USB-C Charge Cable (661-06670) or USB-C to USB-A Cable (923-00504)



- A host computer with:
  - macOS Catalina 10.15 or later
  - Mac Configuration Utility (MCU). See the [latest Apple Service Toolkit download links and documentation](#) (OP476).
  - An internet connection
- An external hard drive of equal or greater storage capacity than the storage capacity of the user's computer  
**Note:** The external hard drive will be configured and password protected with the user's computer serial number during the data transfer.

## Steps:

1. Add Retail Data Transfer Setup (076-00399) or ASP Transaction Only Data Transfer Setup - Transaction Only (076-00410) to the repair and save the repair.
2. Open the AST 2 [Diagnostic Console](#) and enter the user computer's serial number to start a diagnostic session.
3. Connect the user's computer to the host computer. If the host computer doesn't have a USB-C port, use a USB-C to USB-

A cable.

**Important:** You must connect the USB-C cable to the correct port on the user's computer.

**Notebooks:** Use the USB-C port closest to the Caps Lock key.



**iMac Pro and iMac (Retina 5K, 27-inch, 2020):** Use the USB-C port closest to the Ethernet port.



**Mac mini (2018):** Use the USB-C port closest to the HDMI port.





**Mac Pro (2019):** Use the USB-C port closest to the edge.



**Mac Pro (Rack, 2019):** Use the USB-C port closest to the power button.

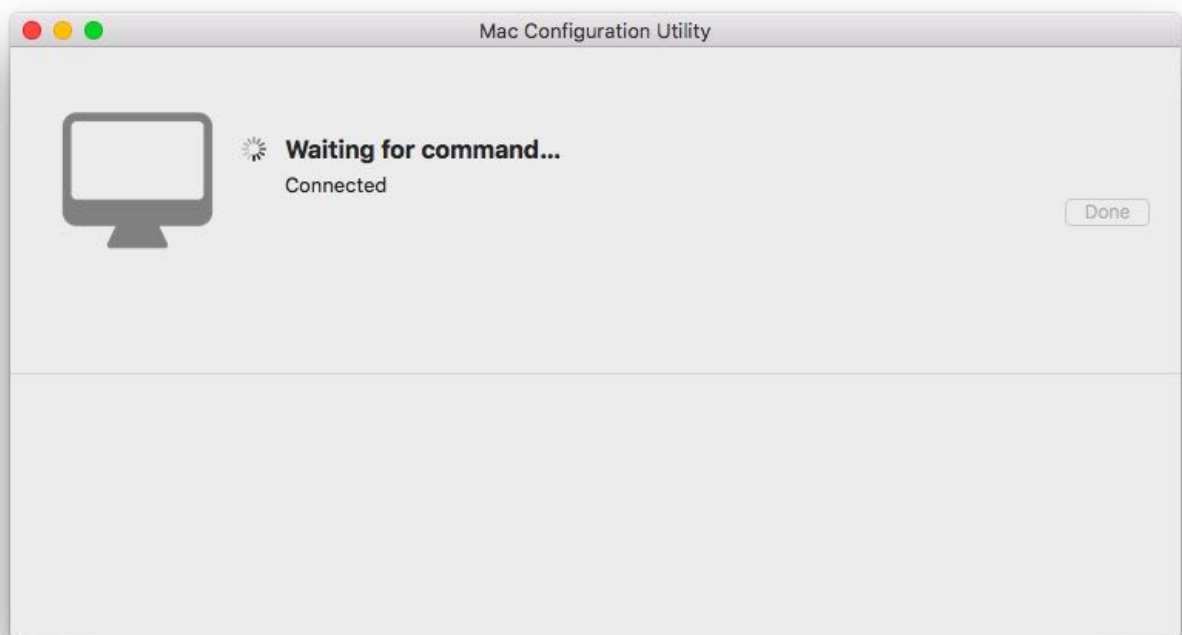
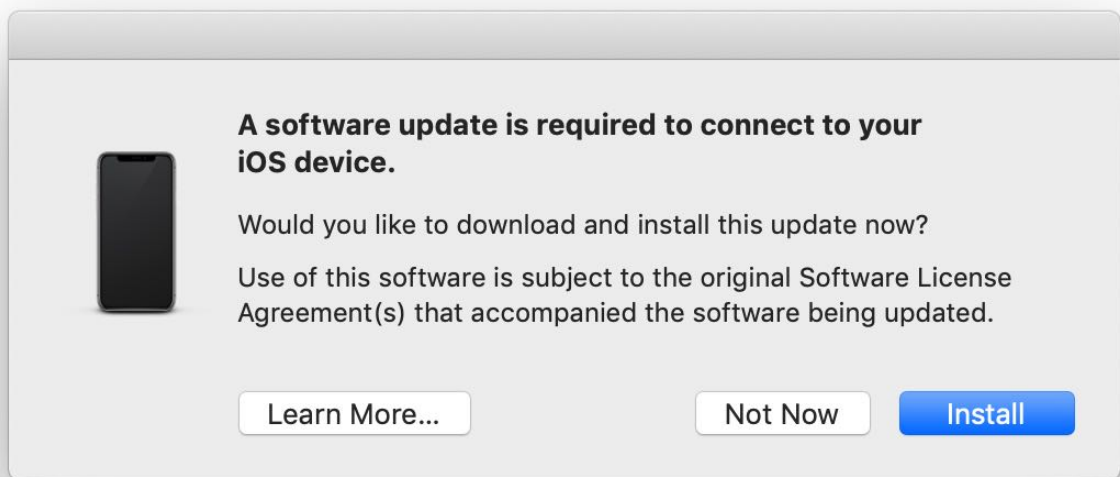


4. Turn on the host computer, connected it to power, and connected it to the internet.
5. Start up the user's computer in [DFU mode](#) (TP1758).
  - [For desktop computers](#) (SV402), press and hold the power button while connecting the power cord until the prompt appears in Mac Configuration Utility, which may take up to 10 seconds.
  - [For notebooks](#) (SV401), press and hold the power button, then press and hold Left Control-Left Option-Right Shift until the prompt appears in Mac Configuration Utility, which may take up to 10 seconds.

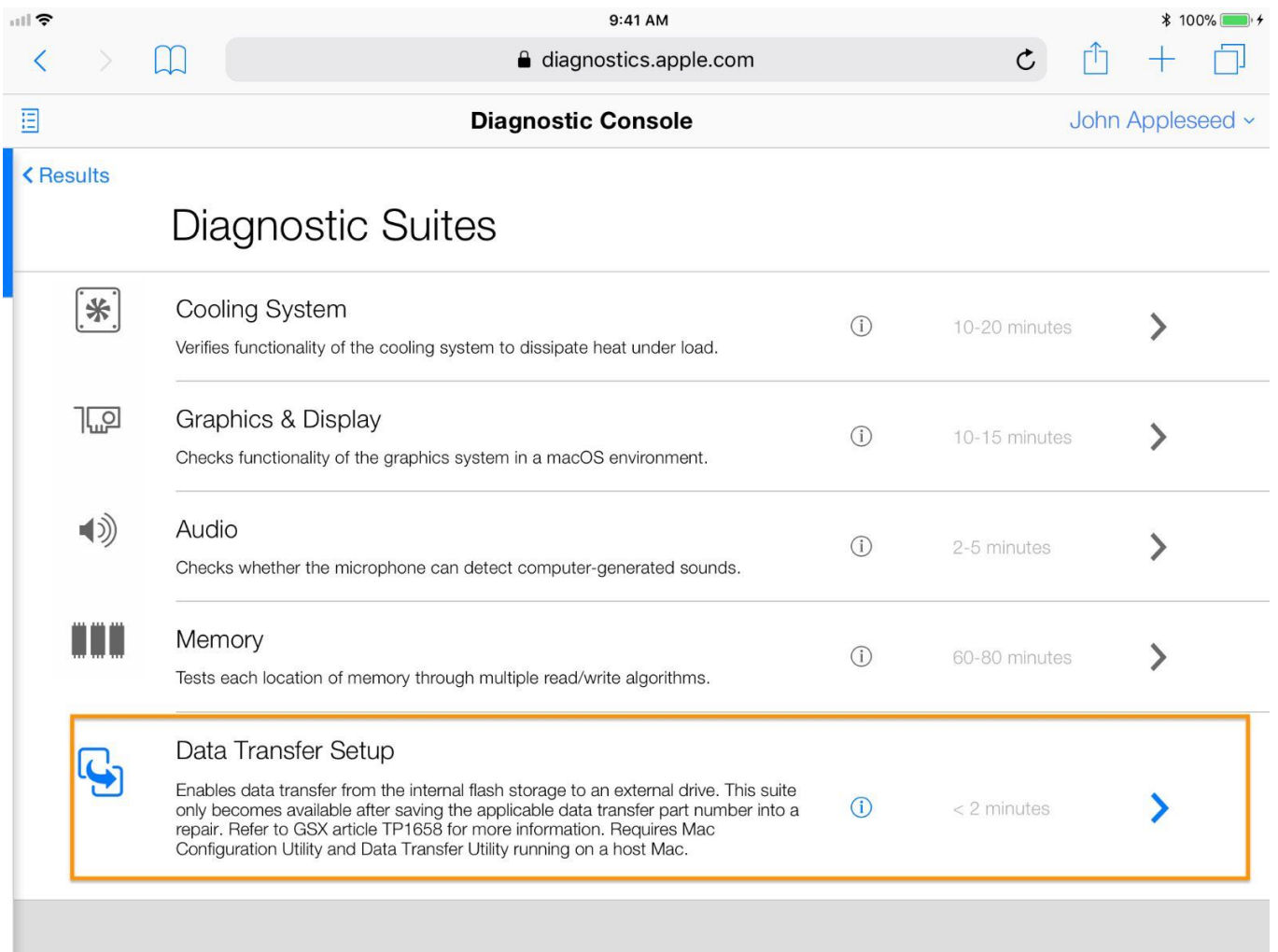


**Note:** If an alert message appears prompting a software update, choose “Install.” After the installation is complete, continue to the next step in the System Configuration process. MCU will automatically launch and a dialog box will appear on the host computer screen.





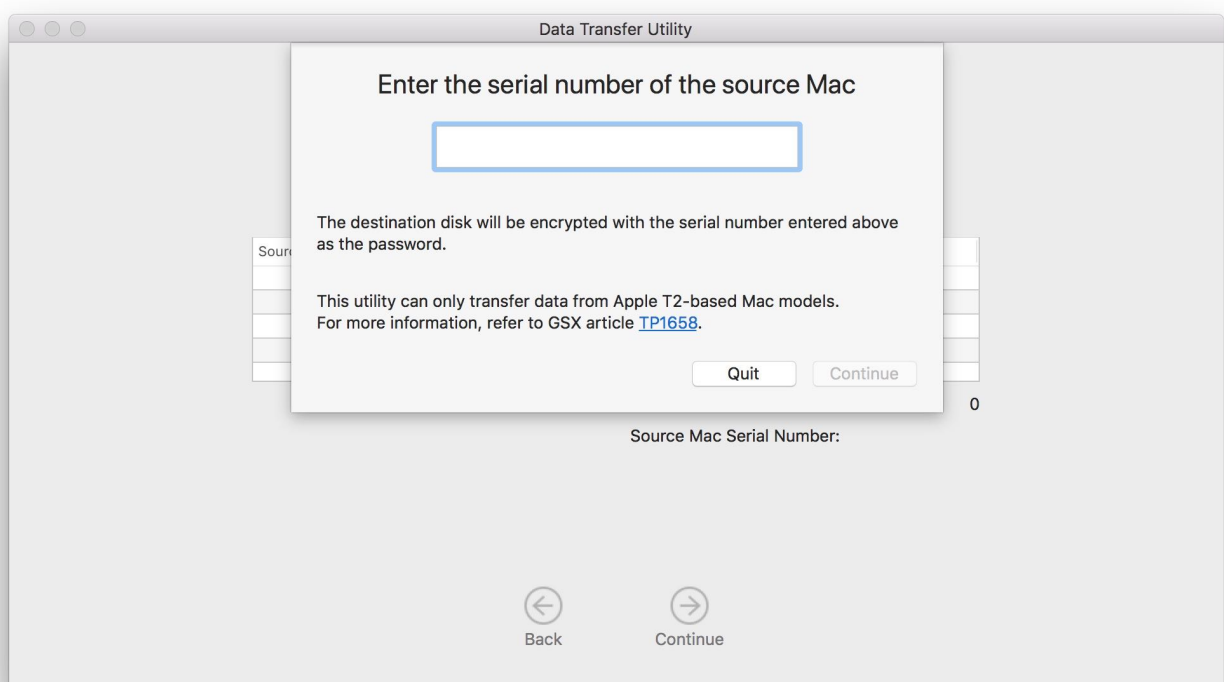
6. Select Data Transfer Setup from the list of diagnostic suites in the Diagnostic Console.



**Note:**

- If the user's computer has FileVault enabled, you will be prompted to enter the password.
- Nothing will appear on the user's computer screen to indicate status. The only status indication will be when the drive mounts as an external volume on the host computer running MCU.

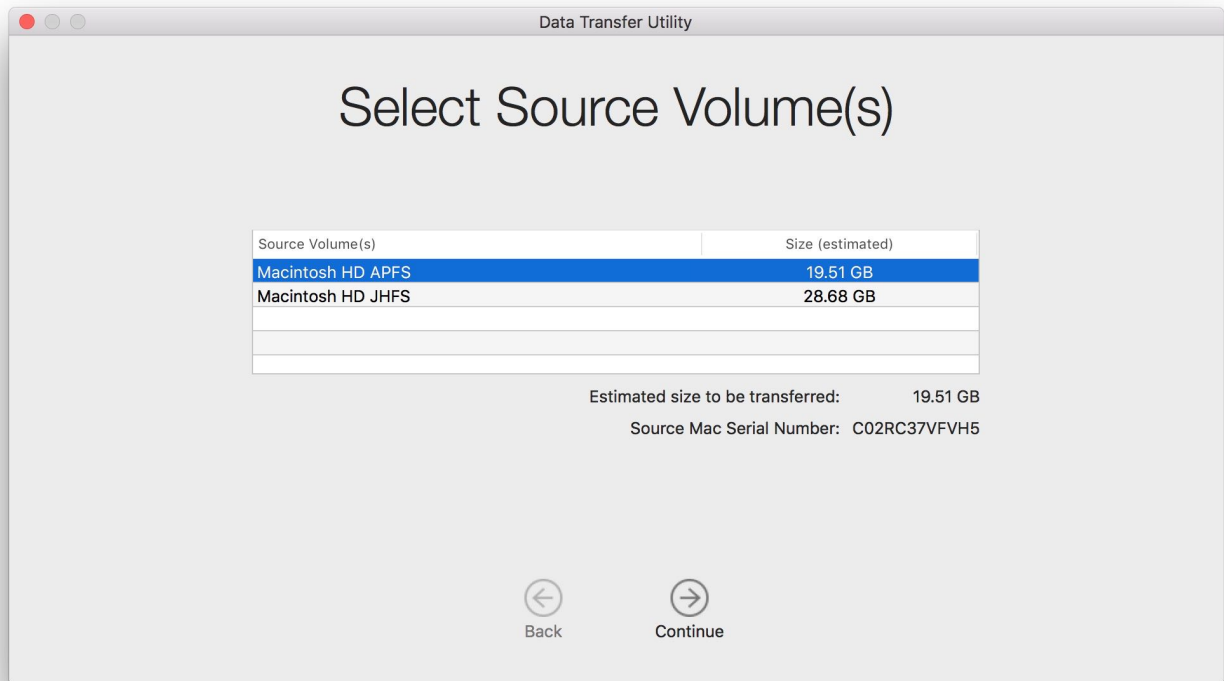
7. Open the Data Transfer Utility app on the host computer and enter the serial number of the user's computer.



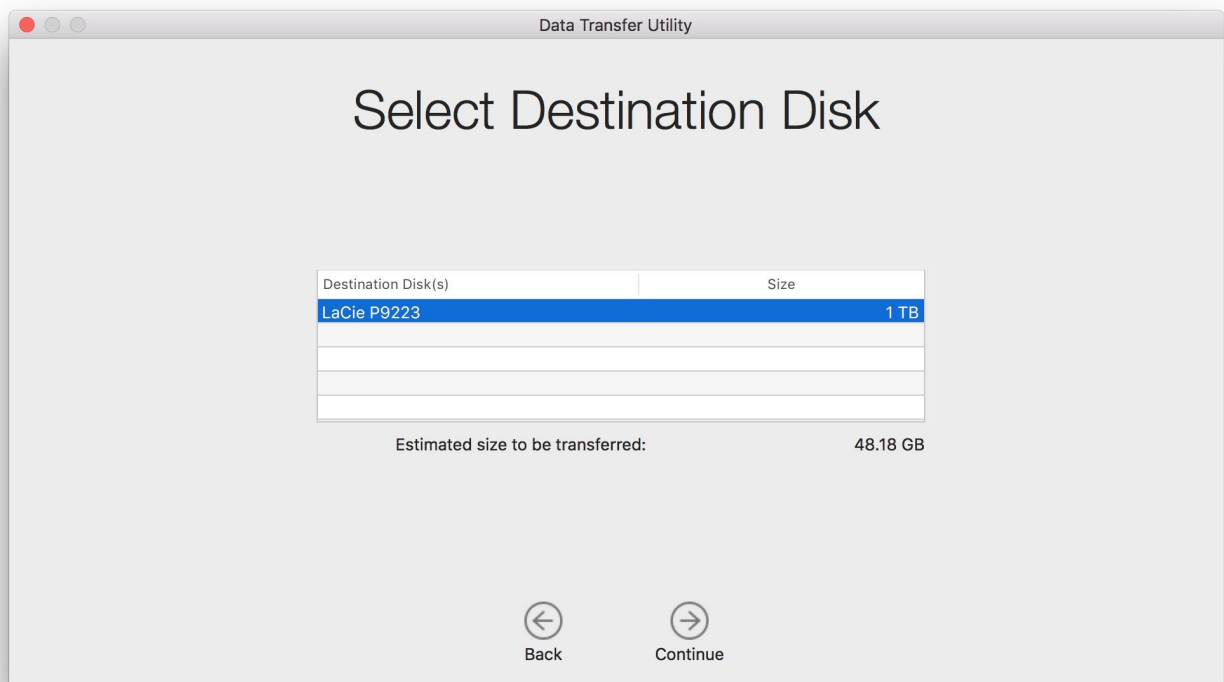


8. Select the source volume and click Continue.

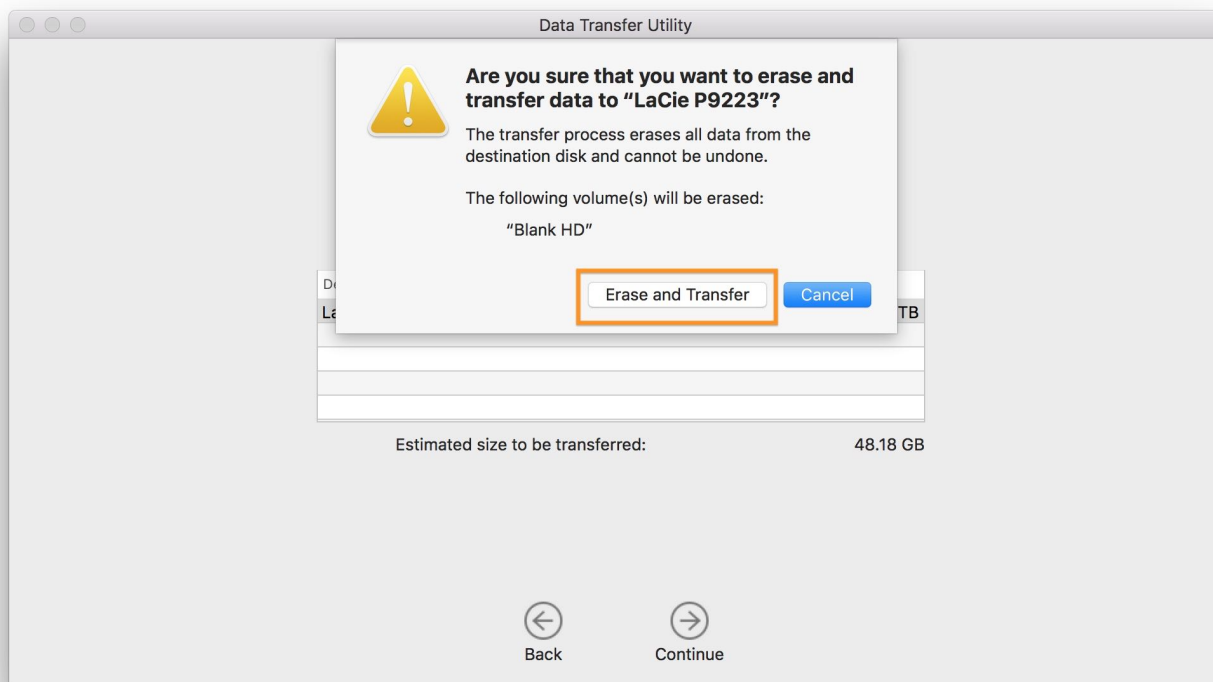
**Note:** If more than one source volume is available, you can select multiple volumes to transfer.



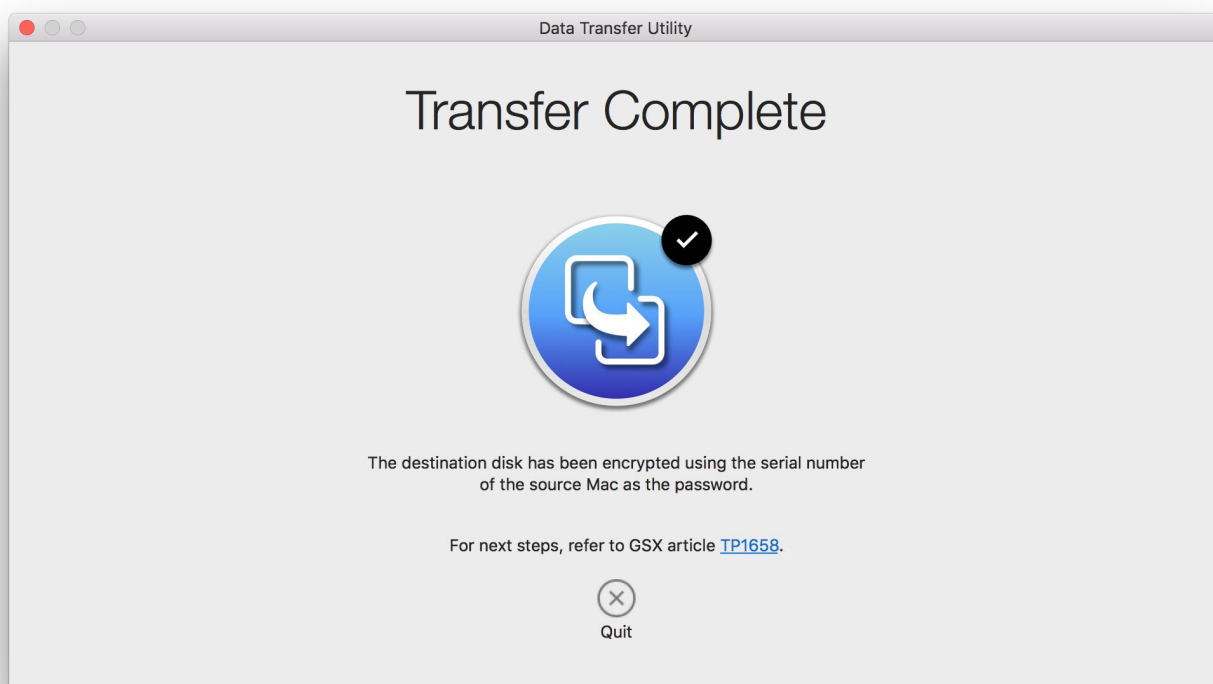
9. Connect an external hard drive to the host computer. Select the destination, and click Continue.



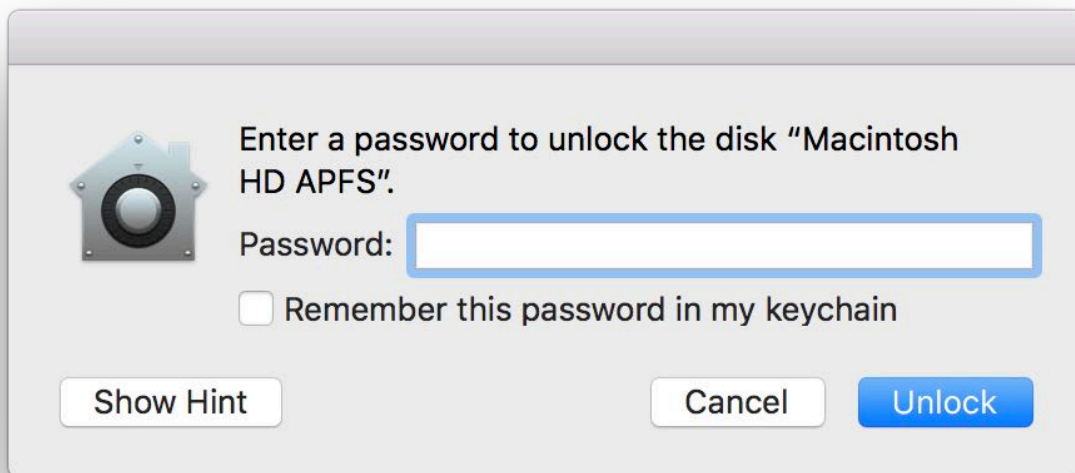
10. Click Erase and Transfer.



11. Confirm that the transfer is successful before closing the repair. Once you close the repair, you can't transfer data again from the known bad (KBB) logic board.



12. Ensure that the password works and the external hard drive is encrypted by disconnecting it from and reconnecting it to the host computer.



### Troubleshooting Tips:

If the Data Transfer Setup suite is unavailable, verify the following information:

1. You added the correct data transfer part number and saved—but didn't close—the repair.
2. You entered the correct serial number of the user's computer into the Diagnostic Console.
3. You used the serial number of the user's computer to create the repair.
4. You correctly connected the user's computer to the host computer, and Mac Configuration Utility is running. A correctly connected device will show as "Apple Mobile Device (DFU Mode)" in System Information > USB.
5. You didn't use a USB-C to USB-A cable with USB-C to USB Adapter.

If the user's computer doesn't complete the Data Transfer Setup suite, perform the following steps:

1. Archive and restart the diagnostic session. Re-run the Data Transfer Setup suite.
2. Restart the host computer.

If the Data Transfer Utility app doesn't show any volumes under Select Source Volume(s), verify the following information:

1. Volume(s) appear in Finder or Disk Utility.
2. You entered the correct serial number of the user's computer into the Data Transfer Utility app.

If the Data Transfer Utility app doesn't recognize the external hard drive, use Disk Utility to initialize the external hard drive.



# Visual/Mechanical Inspection (VMI) Guide for Mac - Table of Contents

- [Displays](#)
- [Liquid Contact](#)
- [Notebook Power Adapters](#)
- [Notebook USB-C Cables](#)

# LCD Pixel Anomalies

When displaying a single color over the screen area, the liquid crystal display (LCD) might show one or more pixels that are not properly lit.

LCD technology uses rows and columns of addressable points (pixels) that render text and images on the screen. Each pixel has three separate subpixels (red, green, and blue) that allow an image to render in full color. Each subpixel has a corresponding transistor responsible for turning the subpixel on and off.

Depending on the display size, there can be thousands or millions of subpixels on an LCD. For example, the LCD used in iMac (27-inch, Late 2013) has a display resolution of 2560 by 1440, which means there are 3.7 million pixels. Each pixel is made up of a red, a green, and a blue subpixel, resulting in over 11 million individual picture elements on the 27-inch display. Occasionally, a transistor may not work perfectly, resulting in the affected subpixel remaining off (dark) or on (bright). With the millions of subpixels on a display, it is possible to have a low number of such transistors on an LCD. In some cases, a small piece of dust or other foreign material may appear to be a pixel anomaly. Apple strives to use the highest-quality LCD displays in its products, but pixel anomalies can occur in a small percentage of them.

In some cases, pixel anomalies are caused by a piece of foreign material that is trapped inside the display or on the surface of the display or glass panel. Foreign material is typically irregular in shape and is usually most noticeable when viewed against a white background.

- For any computer, foreign material on the surface of the display or glass panel can easily be removed using a lint-free cloth.
- For any computer, foreign material trapped inside the display can only be resolved by replacing the entire display assembly.

# General Troubleshooting

## Update Software and Firmware

First ensure that the correct version of macOS is installed on the computer, and check for and apply the latest software and firmware updates. If the computer has an incompatible Mac operating system, it might not finish starting up, display a prohibitory symbol at startup, or behave in other unexpected ways. [Determine if the computer has an incompatible Mac operating system](#) (HT201686), and update to a compatible one.

Firmware is software that's written into memory circuits like flash memory, which holds the software code indefinitely.

To update firmware on an Intel-based Mac computer without an Apple T2 Security Chip, connect the computer to the internet, choose Apple menu > About This Mac, then click Software Update.

For Mac computers with an Apple T2 Security Chip, system management controller (SMC) and extensible firmware interface (EFI) updates are installed as part of macOS software update.

When the firmware is restored on a Mac that contains an Apple T2 Security Chip, the firmware on the Apple T2 Security Chip and on any volumes on your internal flash storage is also restored. When this process is complete, any data on any flash storage volumes is unrecoverable. The [Apple Configurator 2 User Guide](#) provides more information on firmware restoration for Mac computers with the Apple T2 Security Chip.

When a Mac is running a beta version of a new macOS, the firmware installed on the Mac is newer than the firmware supported in AST 2 diagnostics. Therefore computers running macOS beta software must be downgraded before performing any hardware repair. The [Apple Configurator 2 User Guide](#) provides more information on downgrading firmware for Mac computers with the Apple T2 Security Chip.

## Software Troubleshooting

Determine if the computer has a [general software issue](#) (HT201516) or one of the following specific software issues before troubleshooting hardware issues:

- [Incompatible software](#) (HT201861)
- [A folder with a flashing question mark](#) (HT204323)
- [macOS reinstallation issue](#) (HT204904)
- [Fusion Drive issue](#) (HT202574)



# Quick Check Procedures

## Resetting the System Management Controller

[Reset the System Management Controller](#) (SMC) (HT201295) If the computer has the following issues:

- The computer doesn't start up, doesn't display video, has sleep or fan noise issues, or other power issues.
- [The fans run at full speed](#) (HT204463) when you press the power button while inserting the power cord in a Mac (2020 and earlier) with an Apple T2 Security Chip.

## Resetting Nonvolatile RAM

[Reset the Nonvolatile RAM \(NVRAM\)](#) (HT204063) if the computer has the following issues:

- Issues related to settings that can be stored in NVRAM
- Volume, display resolution, startup-disk selection, time zone, and recent kernel panic information
- The computer starts up from a disk other than the one selected in Startup Disk preferences.
- A questions mark icon briefly appears before the computer starts up.

The settings stored in the computer's NVRAM vary depending on the type of computer, connected devices, and drives.

## Starting Up in Safe Mode

[Start the computer in safe mode](#) (HT201262) for the following reasons:

- To perform certain checks and prevent some software from automatically loading or opening
- To resolve or isolate certain issues on the startup disk

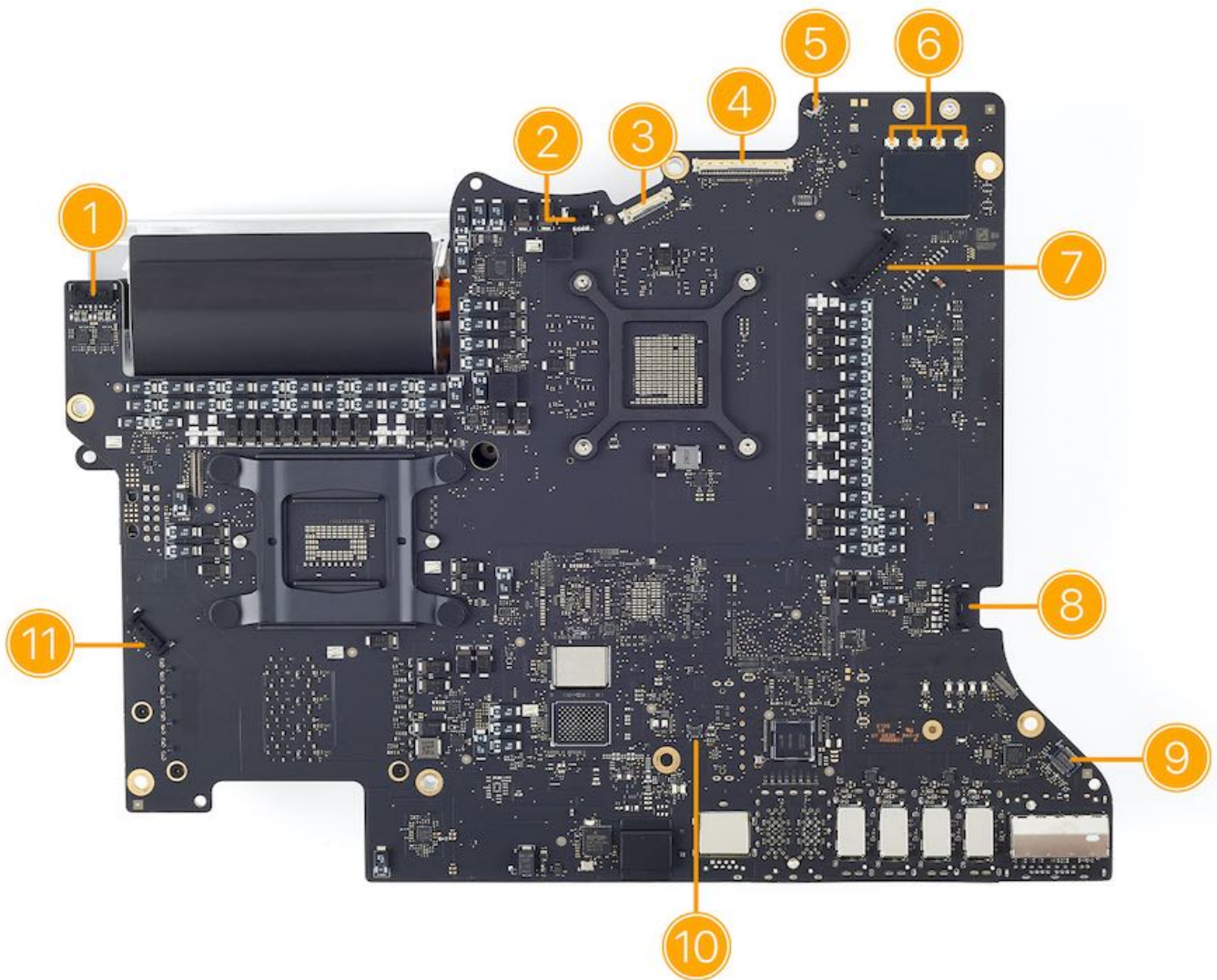
## Device Firmware Update Mode

If the computer is unresponsive, put it in [Device Firmware Update \(DFU\) mode](#) (TP1758). Then you can attempt to revive or restore the computer's firmware in [Apple Configurator 2](#) (TP1875).

# iMac (Retina 5K, 27-inch, 2020) Functional Overview

## Front of Logic Board

Refer to this diagram for symptoms related to connectors on the front of the logic board. Click image to enlarge.



1. **Left speaker**
  - No sound from left speaker
  - Distorted sound from left speaker
2. **Fan**
  - System shuts down if fan is disconnected or blocked
  - System freezes or kernel panics
  - Noisy fan perception
3. **Camera, camera indicator light, and ambient light sensor (ALS)**
  - No camera function and no camera indicator light
4. **Embedded DisplayPort (eDP) Video**
  - Poor or no video on internal display
5. **Rear Microphone**
  - No input or distorted internal microphone input (with Internal Microphone selected in Sound Input Preferences)
6. **Wireless Antenna Connectors (left to right)**
  - **Rear housing Wi-Fi antenna**
  - **Bluetooth antenna**
  - **Middle Wi-Fi antenna**
  - **Lower Wi-Fi antenna**
    - Weak signal strength over Wi-Fi or Bluetooth
    - Cannot connect to Wi-Fi networks or Bluetooth peripherals
    - Slow Wi-Fi or Bluetooth connection speed
7. **Display power (backlight control)**
  - No LED backlight on internal display
  - Open backlight fuse F8100 on logic board

**8. Right speaker**

- No sound from right speaker
- Distorted sound from right speaker

**9. Audio input/output**

- No external analog audio input
- No external analog audio output
- No headset controls or microphone input

**10. Dual Chin Microphones**

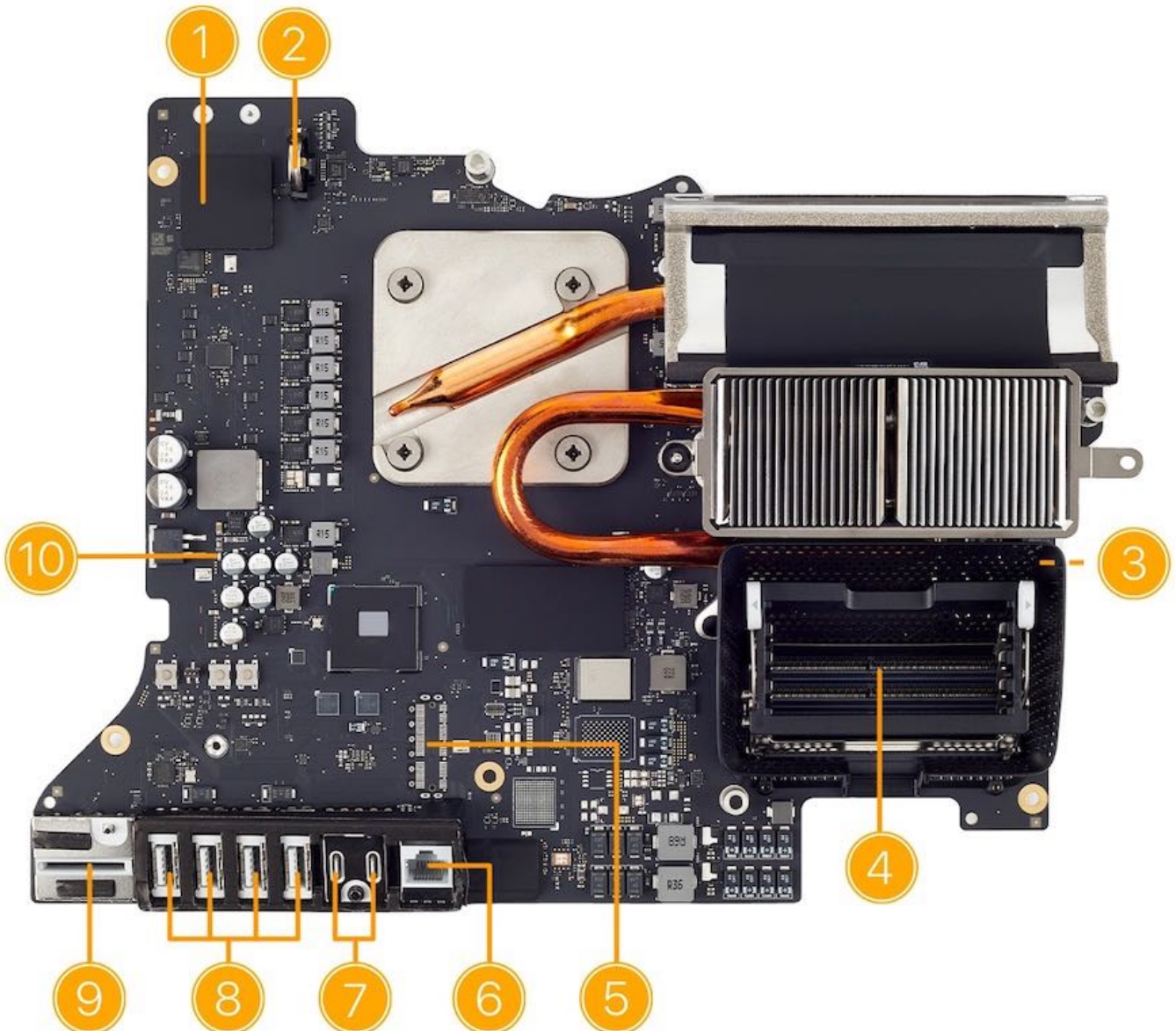
- No input or distorted internal microphone input (with Internal Microphone selected in Sound Input Preferences)

**11. Power on signal and power supply temperature sensor**

- No power
- Intermittent shutdown (if cable is pinched or damaged)
- Fan runs at full speed

**Back of Logic Board**

Refer to this diagram for symptoms related to the connectors on the back of the logic board. Click image to enlarge.



**1. Integrated wireless card**

- Cannot enable Wi-Fi and/or Bluetooth
- Wi-Fi is not seen in System Information > Network > Wi-Fi
- Bluetooth is not seen in System Information > Bluetooth

**2. Backup battery**

- No power
- No video

**3. DC Power**

- No power

**4. Memory**

- No boot
- Freezes or kernel panics

**5. Flash storage**



**Important:** Certain configurations of the logic board will include a flash storage connector and flash storage module. Don't remove the flash storage module if one is installed. It is paired to the storage on the logic board by the Apple T2 Security chip.

- No boot
- No flash storage seen in System Information > Storage

6. **Ethernet RJ-45**

- No wired Ethernet connectivity
- Wired Ethernet data transfer issues

7. **USB-C ports (2)**

- USB connectivity issues
- USB power issues
- No video to external display
- No audio to external display speakers
- Thunderbolt device not found
- Thunderbolt controller not recognized
- Thunderbolt driver issue
- Thunderbolt power issues

8. **USB 3 ports (4)**

- USB connectivity issues
- Data transfer issues

9. **SD Card**

- No SD card seen in System Information > Card Reader
- Data transfer issues

10. **Backlight fuse (F8100)**

- No LED backlight on internal display

# iMac (Retina 5K, 27-inch, 2019 and 2020) Diagnostic LEDs and Test Pads

## Scope of this Document:

This article provides information on diagnostic LEDs, coin battery voltage test pads, and real-time clock (RTC) reset pads for iMac (Retina 5K, 27-inch, 2019 and 2020). The diagnostic LEDs and two pairs of test pads can help you troubleshoot the computer without removing the logic board.

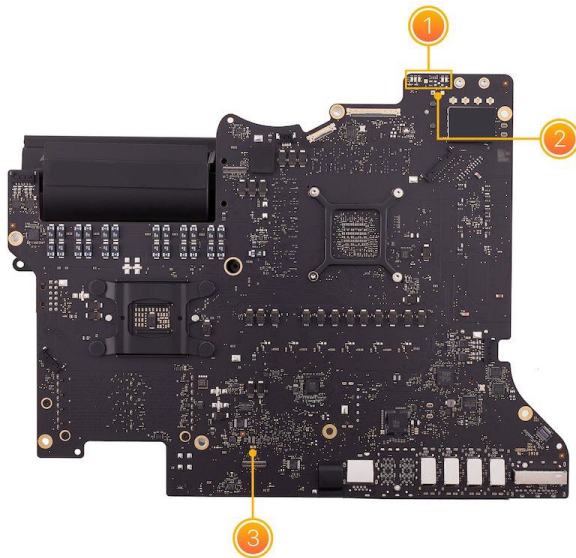
- The coin battery, located on the back of the logic board, provides power to the real-time clock (RTC) and nonvolatile random-access memory (NVRAM) when the computer is not connected to an AC power source.
- The RTC maintains the date and time, while the NVRAM stores information such as speaker volume, screen resolution, startup disk selection, and recent kernel panics.
- The coin battery is designed to last several years and does not normally require replacement. However, if there are issues with the functions listed above, the RTC and NVRAM may need to be reset or the coin battery may need to be replaced.

(1) = Diagnostic LEDs

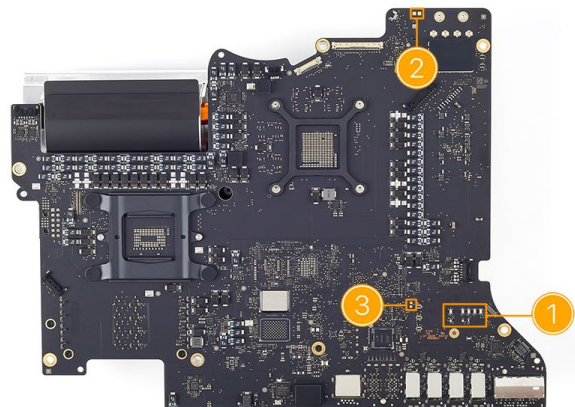
(2) = Coin battery voltage test pads

(3) = RTC reset pads

iMac (Retina 5K, 27-inch, 2019)



iMac (Retina 5K, 27-inch, 2020)



## Warning! Electrical Shock Hazard:

- Be extremely careful when working inside the computer while power is applied and the system is energized. Don't touch the logic board or power supply while the computer is plugged in.
- The power supply and logic board remain powered when the computer is plugged in whether or not the computer has been turned on.
- After unplugging the computer from the electrical outlet, wait two minutes for the power supply and logic board to discharge before removing the display, disconnecting modules, or substituting cables and components.
- Install [protective covers](#) (TP833) over the power supply and logic board after the display has been removed.



## Electrical Safety Precautions

Before working on a computer with exposed, potentially energized parts:

- Follow these additional [safety precautions](#) (TP820) when performing troubleshooting steps that require you to operate the computer when it is plugged into an electrical outlet and the display is removed:
  - Remove rings, watches, necklaces, metal-rimmed eyewear, and other metallic articles which increase your risk of electric shock.
  - Do not wear a cell phone or other signaling device, as these may cause a dangerous startle reflex during energized work.
  - **If the iMac needs to be plugged in for LED checks or similar troubleshooting, do NOT wear an ESD wrist strap.** Wearing an ESD grounding system increases your risk of electric shock in this situation.
  - Remain alert, focused on the work being performed, and aware of the proximity of grounded objects to your body.
  - Use a black stick or other non-metal extension tool as needed to connect or disconnect cables, to keep fingers away from potentially energized parts.

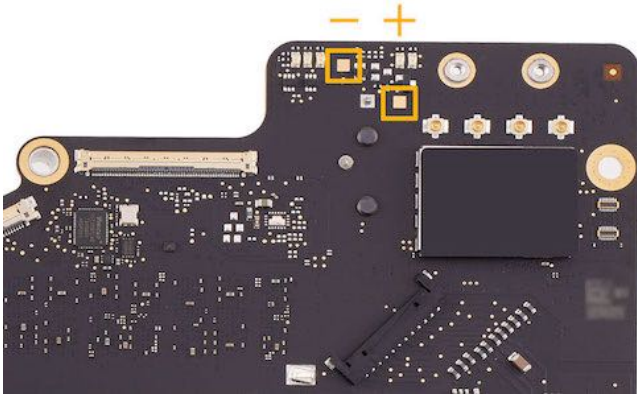
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## Coin Battery Voltage Test Pads

1. Shutdown and unplug the computer from the electrical outlet and wait two minutes for the power supply and logic board to discharge.
2. Install a protective cover over the power supply.
3. Measure the coin battery voltage by using a voltmeter set for DC. Place the probes on the pads. If the voltage is 2.7 volts DC or less, then the coin battery should be replaced.

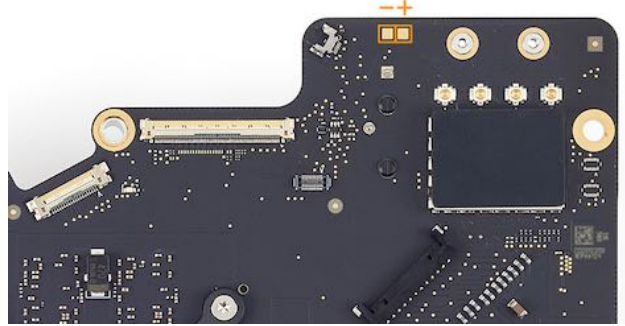
iMac (Retina 5K, 27-inch, 2019)

- (–) **negative** (same as chassis ground)
- (+) **positive**



iMac (Retina 5K, 27-inch, 2020)

- (–) **negative** (same as chassis ground)
- (+) **positive**



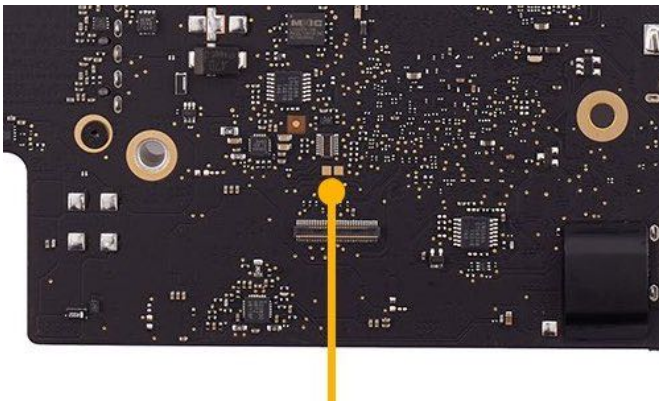
### Real-Time Clock (RTC) Reset Pads

1. Shut down and unplug the iMac. Allow approximately two minutes for the power supply to discharge.
2. Install a protective cover over the power supply.
3. Reset the RTC by shorting the pads shown below. Use the tip of a flat-blade screwdriver to touch both pads at the same time.

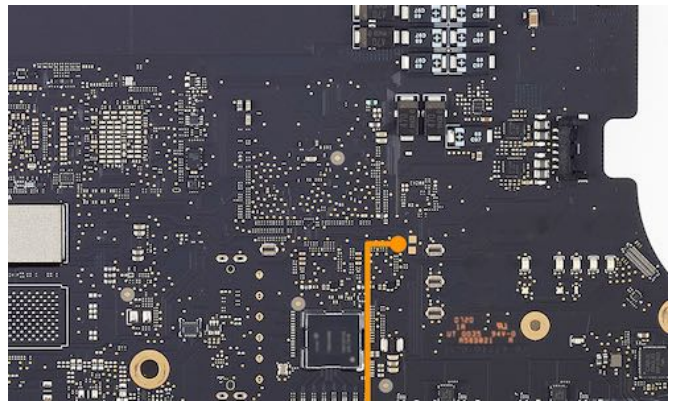


**Caution:** Do not make contact with any of the surrounding components or traces while performing this procedure. Some of the smaller components can be broken off very easily. Physically damaged boards warrant a logic board replacement.

iMac (Retina 5K, 27-inch, 2019)



iMac (Retina 5K, 27-inch, 2020)



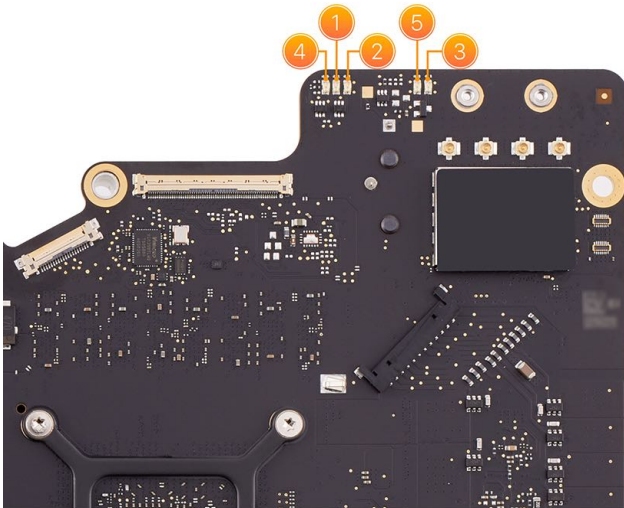
### Diagnostic LEDs

- For iMac (Retina 5K, 27-inch, 2019) refer to both of the images below and match either Sequence A or Sequence B to the model you are working on.
- There is only one sequence for iMac (Retina 5K, 27-inch, 2020).
- See the full description of LED behaviors below the following images.

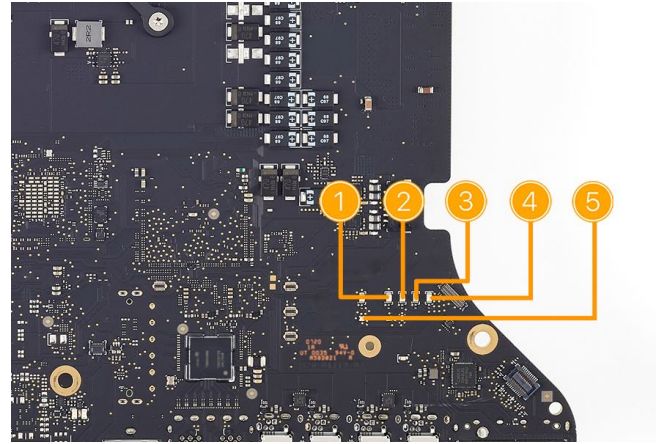


iMac (Retina 5K, 27-inch, 2019)

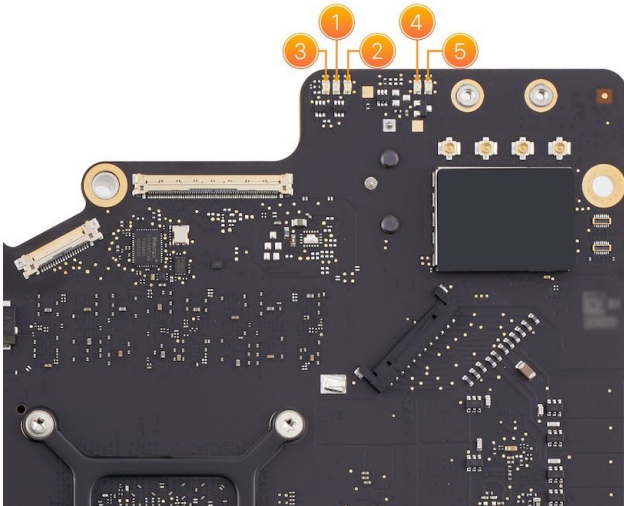
## Sequence A



iMac (Retina 5K, 27-inch, 2020)



## Sequence B



### • LED 1

- Indicates that the trickle voltage from the power supply has been detected by the main logic board. This LED will turn on when you connect the iMac to a working AC power source. The LED will remain on as long as the computer is on or asleep.
- When the computer has been shut down correctly, LED 1 behavior may differ:
  - If a startup event is scheduled in System Preferences/Energy Saver, then LED 1 will stay on after a correct shutdown.
  - If no startup event is scheduled in System Preferences/Energy Saver, then LED 1 will turn off and will stay off as long as the power cord is kept connected and an AC power source is present. Disconnecting the power cord and plugging it back in will turn this LED back on, even if the computer is still off.
- After disconnecting and reconnecting the AC power source, this LED could remain off:
  - If the AC power source is missing or disconnected.
  - If the logic board is disconnected from the power supply or the AC receptacle.
  - If the power supply board is faulty.

### • LED 2

- Indicates that the computer is turned on. This LED will be on as long as the computer is turned on (but is not asleep) and the power supply and voltage regulators are working correctly.

### • LED 3

- Indicates that the logic board and GPU are communicating. This LED will be on when the CPU is communicating properly with the GPU. If LEDs 1 and 2 are on and LED 3 is off, then the backup battery (on the back of the logic board) may need to be reseated or the logic board may need replacement.

### • LED 4

- Indicates that the logic board and LCD panel are communicating. This LED will be on when the computer is turned on and a video signal is being generated. If LED 4 is on and there is no image on the display, then the

LCD panel or the cables between the LCD and logic board might be installed incorrectly or need replacement.

- **LED 5**

- Indicates that the logic board and LCD panel are communicating. This LED is on when the computer is turned on, a video signal is being generated, and the LCD Panel is signaling to turn on the backlight. If LED 5 is ON and there is no image on the display, then the LCD backlight or circuitry on the logic board may be malfunctioning. The LCD panel or the cables or the logic board may need replacement.

## **LED Startup Sequence**

- **LED 1 = Power is available.**

- If no LED is visible:
  - Disconnect the power cord from the computer and wait 15 seconds to reset the power supply and LED status. Reconnect the power cord and check the LED status again.
  - Verify the AC source.
  - Verify that a known-good power cord is connected.
  - Verify the cable connection between the AC inlet and the power supply.
  - Verify the cable connection between the power supply and the logic board.
  - Verify the power supply.

- **LED 1 + LED 2 = Power is available and the system is turned on.**

- If the second LED is not visible when the power button is pressed:
  - Verify that the power button is connected to the power supply.
  - Verify power button functionality.
  - Verify the cable connection between the power supply and the logic board.
  - Verify the power supply.
  - Verify the logic board.

- **LED 1 + LED 2 + LED 3 = Power is available, the system is turned on, and the GPU was found.**

- If the third LED is not visible after the system is turned on:
  - Verify whether the fan is running when turned on (reset SMC and NVRAM, verify backup battery voltage for proper startup).
  - If the fan is not heard, go to the "No Startup" troubleshooting flow.

- **LED 1 + LED 2 + LED 3 + LED 4 = Power is available, the system is turned on, the logic board is communicating with the GPU, and the internal LCD was found.**

- If the fourth LED is not visible after the system is turned on:
  - Verify the embedded DisplayPort cable (eDP) connections between the LCD panel and the logic board.
  - Inspect the LCD display cables for cable damage.
  - Verify external video functionality and proceed according to the result:
    - If an external display works, verify/replace the LCD panel.
    - If an external display does not work, verify/replace the logic board.

- **LED 1 + LED 2 + LED 3 + LED 4 + LED 5 = Power is available, system is turned on, GPU is working, logic board is communicating with the LCD panel, and the LCD panel has turned on the LCD backlight.**

- If the fifth LED is not visible after the computer is turned on:
  - Verify the eDP cable and backlight cable connections between the LCD panel and the logic board.
  - Inspect the LCD display cables for cable damage.
  - Using a flashlight, check the following areas on the panel:
    - Look in the top left corner of the panel to see if there is a dim Apple logo (the Apple menu logo).
    - Look in the center of the panel to see if there is a login screen.
    - Look at the bottom of the panel to see if there is a Dock visible.
    - If the following items are visible, there may be something wrong with the display cables or the logic board. Proceed to the next step.
  - Replace the LCD panel, check that all the LEDs are visible, and that the backlight functions. If the computer does not function after replacing the LCD panel, replace the logic board.

# Testing the Panel Using the Display Extension Cable Kit

## Testing the Panel Using the Display Extension Cable Kit for iMac (27-inch, Late 2012 and later) and iMac Pro (2017)

Use the display extension cable kit to:

- Test the system and/or display before securing the panel to the display adhesive-very high bond (VHB)-strips.
- Test the functionality of the embedded DisplayPort (eDP) cable.



**Warning! Electrical Shock Hazard: Use extreme caution when troubleshooting with the display panel removed. Avoid touching the logic board or power supply while the computer is plugged in, the power supply retains a charge whether or not the computer is on.**

**After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.**

- Never remove or install any physical components while the computer is plugged in to an electrical outlet.
- When plugged in, the power supply and logic board are energized, even when the computer is turned off.
- Unplug the computer and wait two minutes for the power supply and logic board to discharge before removing the display panel.
- Do NOT touch the logic board or the power supply while the computer is plugged in, or before sufficient time has passed to discharge stored voltage to a safe level after being unplugged.

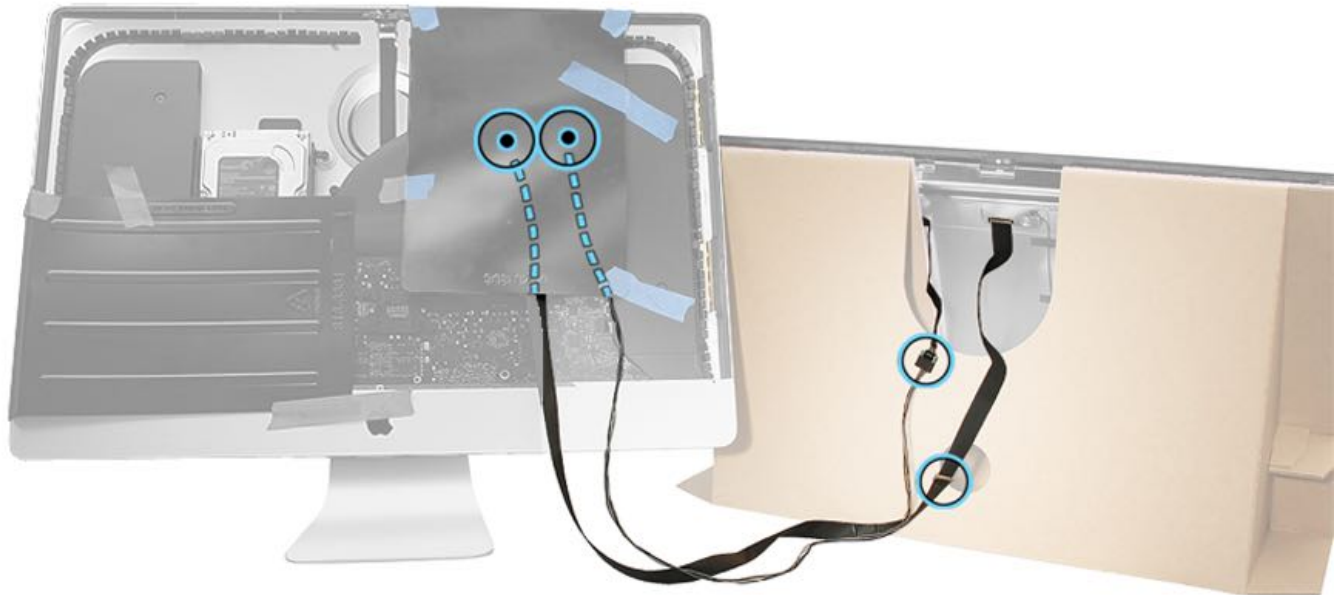
### Electrical Safety Precautions

Before working on a computer with exposed, potentially energized parts:

- Remove rings, watches, necklaces, metal-rimmed eyewear, and other metallic articles which increase your risk of electric shock.
- Do not wear a cell phone or other signaling device, as these may cause a dangerous startle reflex during energized work.
- **If the iMac needs to be plugged in for LED checks or similar troubleshooting, do NOT wear an ESD wrist strap.** Wearing an ESD grounding system increases your risk of electric shock in this situation.
- Remain alert, focused on the work being performed, and aware of the proximity of grounded objects to your body.
- Use a black stick or other non-metal extension tool as needed to connect or disconnect cables, to keep fingers away from potentially energized parts.

Refer to the following articles for additional information:

- [iMac and Displays: Power Supply Cover Instructions](#)
- [iMac \(27-inch\): Safety](#)
- [iMac Pro \(2017\): Power Supply Cover Instructions](#)
- [iMac Pro \(2017\): Safety](#)



## Tools

- ESD wrist strap and mat
- Black stick
- Power supply protective covers, pack of two (923-0189)
- iMac LCD service support stand (923-0416)
- Kit, display extension cable set (076-1431) for iMac (27-inch, Late 2012 and Late 2013)
- Kit, display extension cable set (076-00010) for iMac (Retina 5K, 27-inch, Late 2014 and later)
- Kit, display extension cable set (076-00373) for iMac Pro (2017)
- Painter's tape

Required for nano-texture glass display, but not shown in the image below:

- Apple polishing cloth for nano-texture glass (923-04724)
- Gloves, anti-static and lint-free (922-8253)





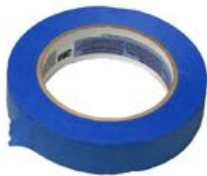
eDP Extension Cable



BLC Extension Cable



eDP Substitution Cable



**Note:** The iMac (27-inch, Late 2013) display and extension cable kit are shown in the images below. Follow the same setup steps and procedures if testing the iMac (Retina 5K, 27-inch, Late 2014 and later) or the iMac Pro (2017), but use the correct display extension cable kit for each.

- iMac (27-inch, Late 2012 and Late 2013): (076-1431)
- iMac (Retina 5K, 27-inch, Late 2014 and later): 076-00010
- iMac Pro (2017): 076-00373

### Procedure #1: Testing the System With the Panel Off, Using Extension Cables

This procedure allows you to test the system with the display removed in order to ensure everything is functioning before securing the panel with very high bond (VHB) adhesive strips.

#### First Steps

1. Remove the display for the model you are servicing:

**Caution:** Wear lint-free gloves (922-8253) when handling an iMac (Retina 5K, 27-inch, 2020) with a nano-texture glass display. Use only the Apple polishing cloth (923-04724) to clean the nano-texture glass.

- For iMac (27-inch, Late 2012-2017):
  - [Display panel removal](#)
  - [Display panel - removing very high bond \(VHB\) strips](#)
- For iMac Pro (2017):
  - [Display panel removal](#)
  - [Display panel - removing very high bond \(VHB\) strips](#)

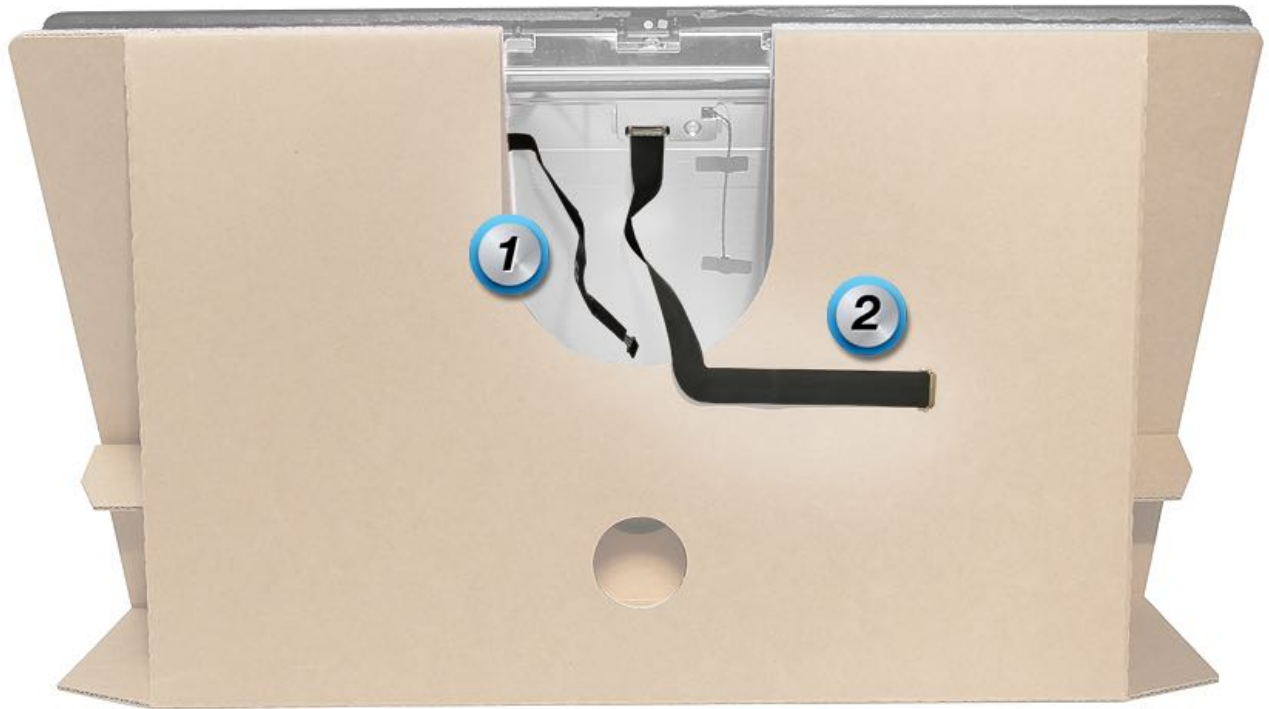


- For iMac (Retina 5K, 27-inch, 2019)
  - [Display removal](#) (includes display adhesive (VHB) removal)
- For iMac (Retina 5K, 27-inch, 2020)
  - [Display removal](#) (includes display adhesive (VHB) removal)

2. Place the display on the iMac LCD service support stand.



3. Orient the iMac LCD service support stand so the display backlight cable (1) and the eDP (2) cable are facing you.



4. Locate the eDP extension cable in the kit.



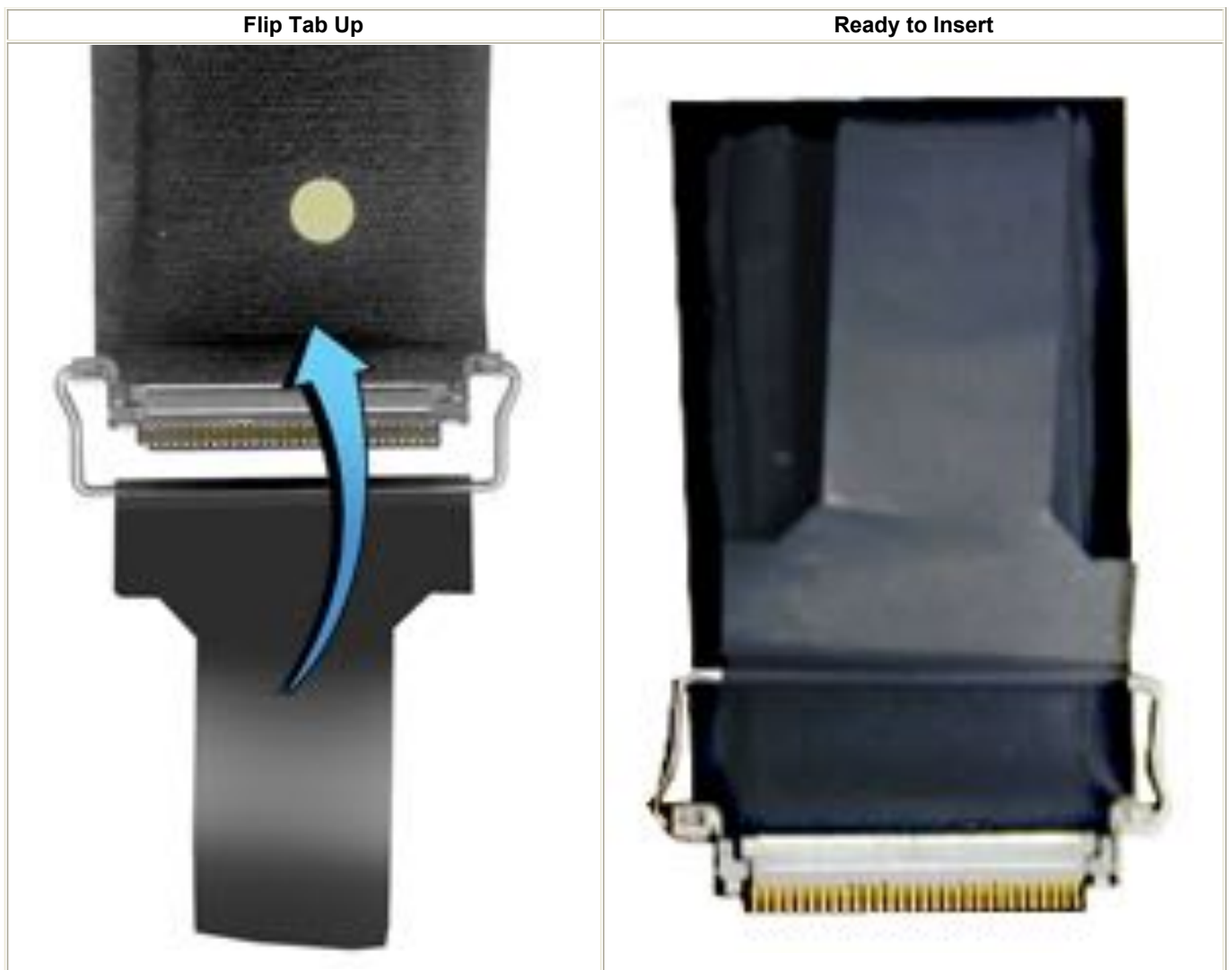
5. Either end of the eDP extension cable can connect to the logic board; the other end connects to the display.

**Important:** Each end of the eDP extension cable has a gold dot to indicate cable orientation. Orient the cable with the gold dot side up when connecting the eDP extension cable to the logic board connector and the end of the eDP cable. Connecting cables upside down (with the brass connector facing up) will damage the logic board and/or the display panel.

**Note:** With proper care, cables will last for approximately 50 insertions. After 50 insertions, cable degradation may occur and Apple recommends ordering a new Display Extension/Substitution Cable Kit (refer to the Tools section above).



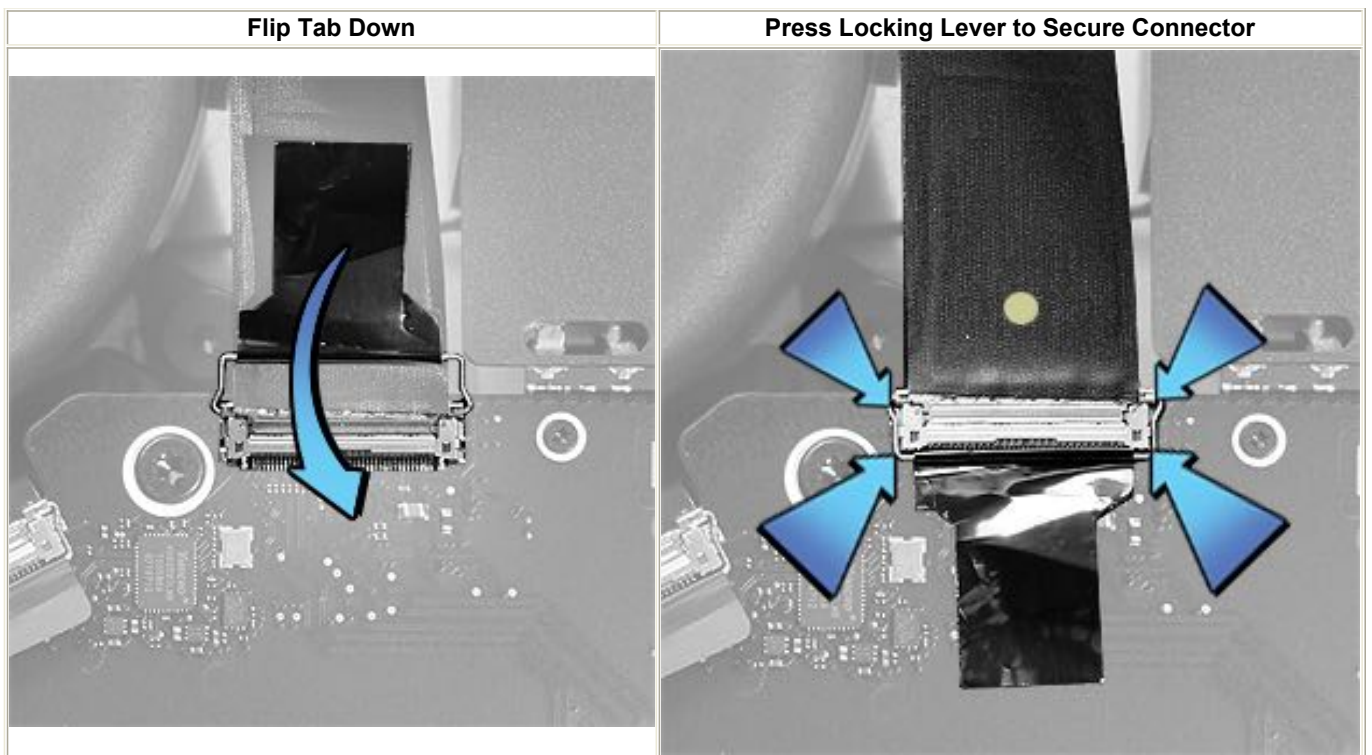
6. Flip the black tab up before connecting the eDP extension cable to the logic board connector.



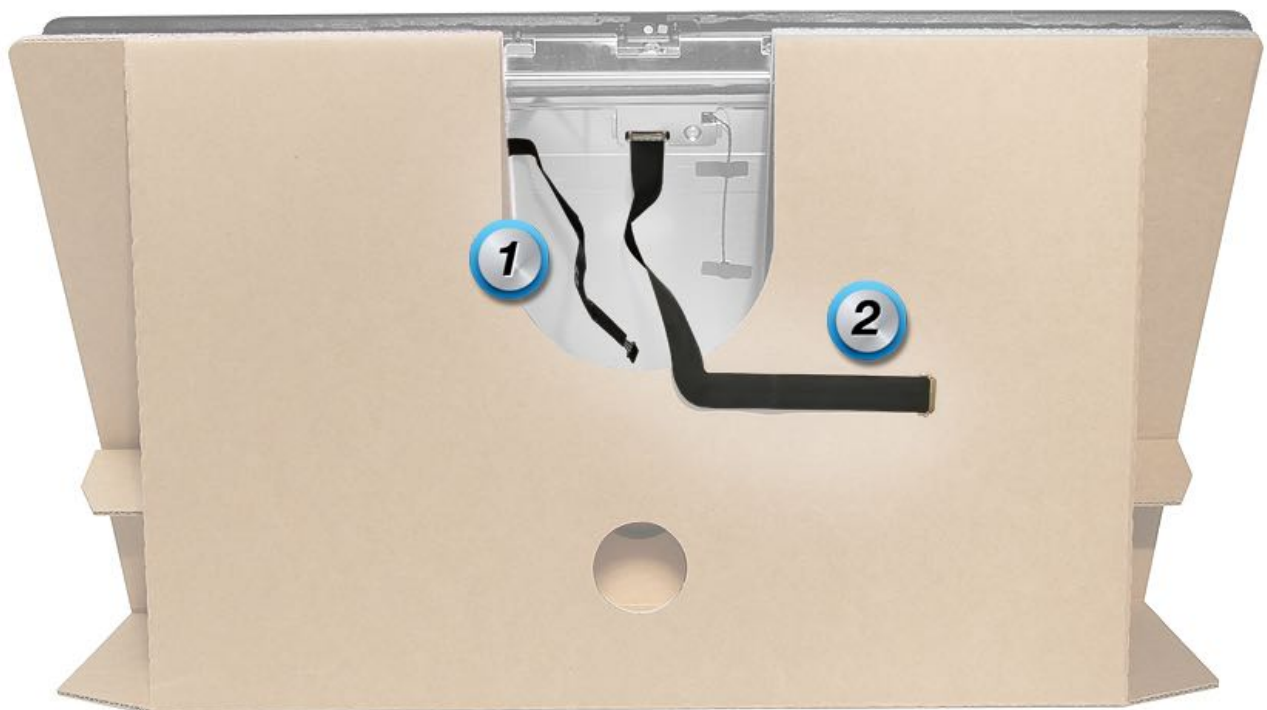
7. With the iMac unplugged, connect the extension cable to the logic board connector. The cable should be aligned straight on with the connector and never inserted at an angle.

**Important:** Ensure that the black tab is attached to the locking lever on the eDP cable. Attaching the locking lever without the black tab may cause damage to the logic board and/or the display.

- Verify that each end of the cable has the gold dot side up.
- Check that the connector is fully seated.
- Flip the black tab down.
- Press the locking lever to secure the cable to the logic board.

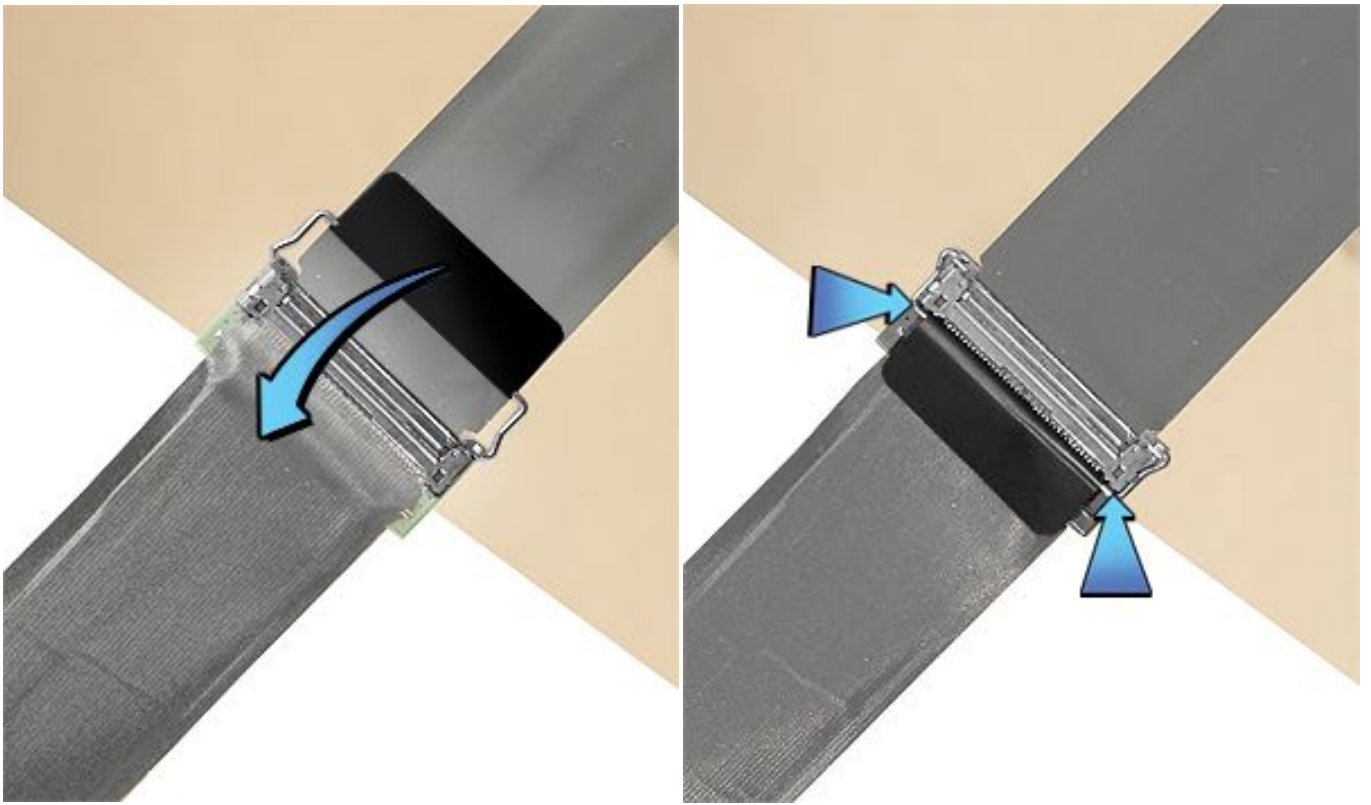


8. Secure the logic board end of the eDP extension cable to the speaker with painter's tape (see step 10).
9. Connect the other end of the eDP extension cable to the end of the dangling DisplayPort cable (2).



10. Securely mate the cable connectors. Flip the black tab over and press the locking lever bar around the connector to secure the cables.





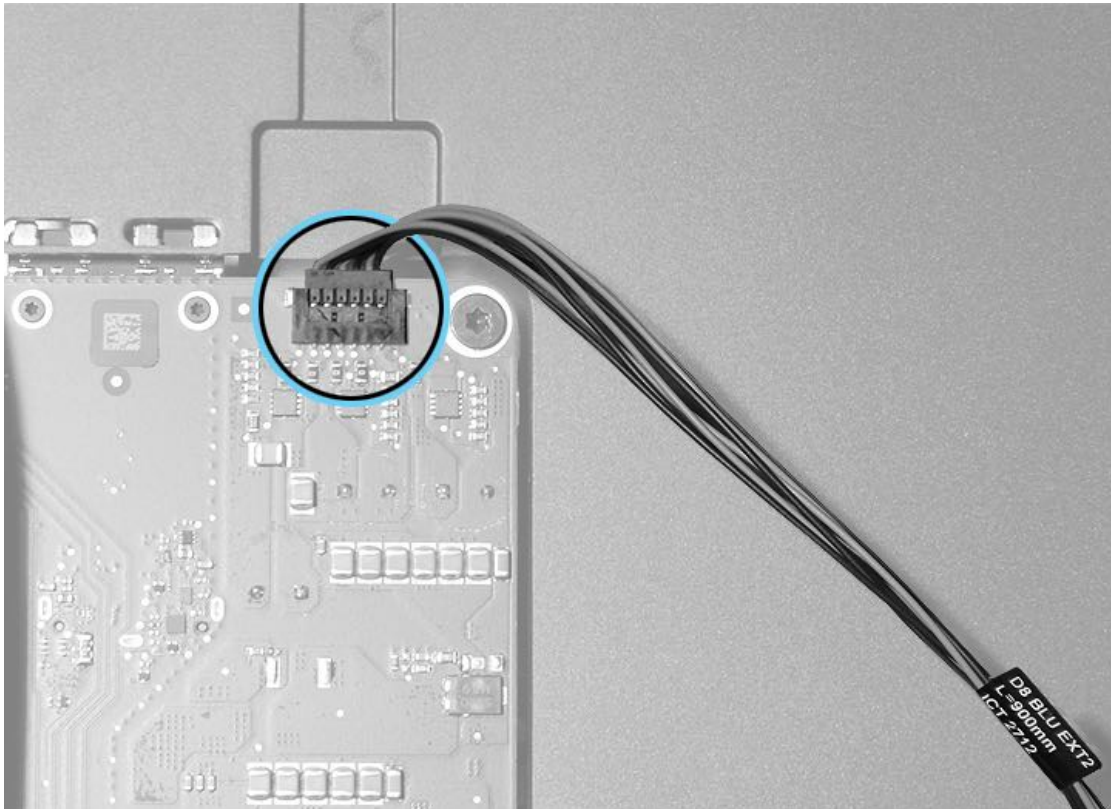
11. The eDP extension cable will look like the image below when connected properly.



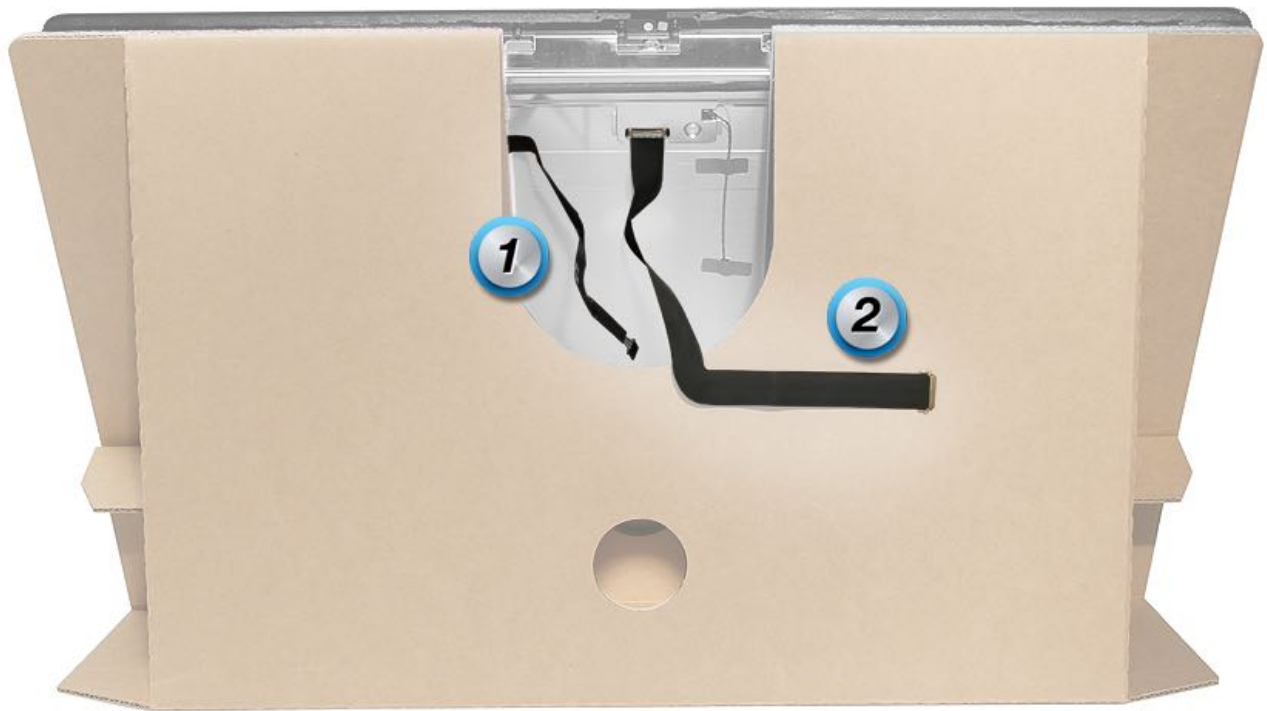
12. Next, locate the backlight extension (BLC) cable.



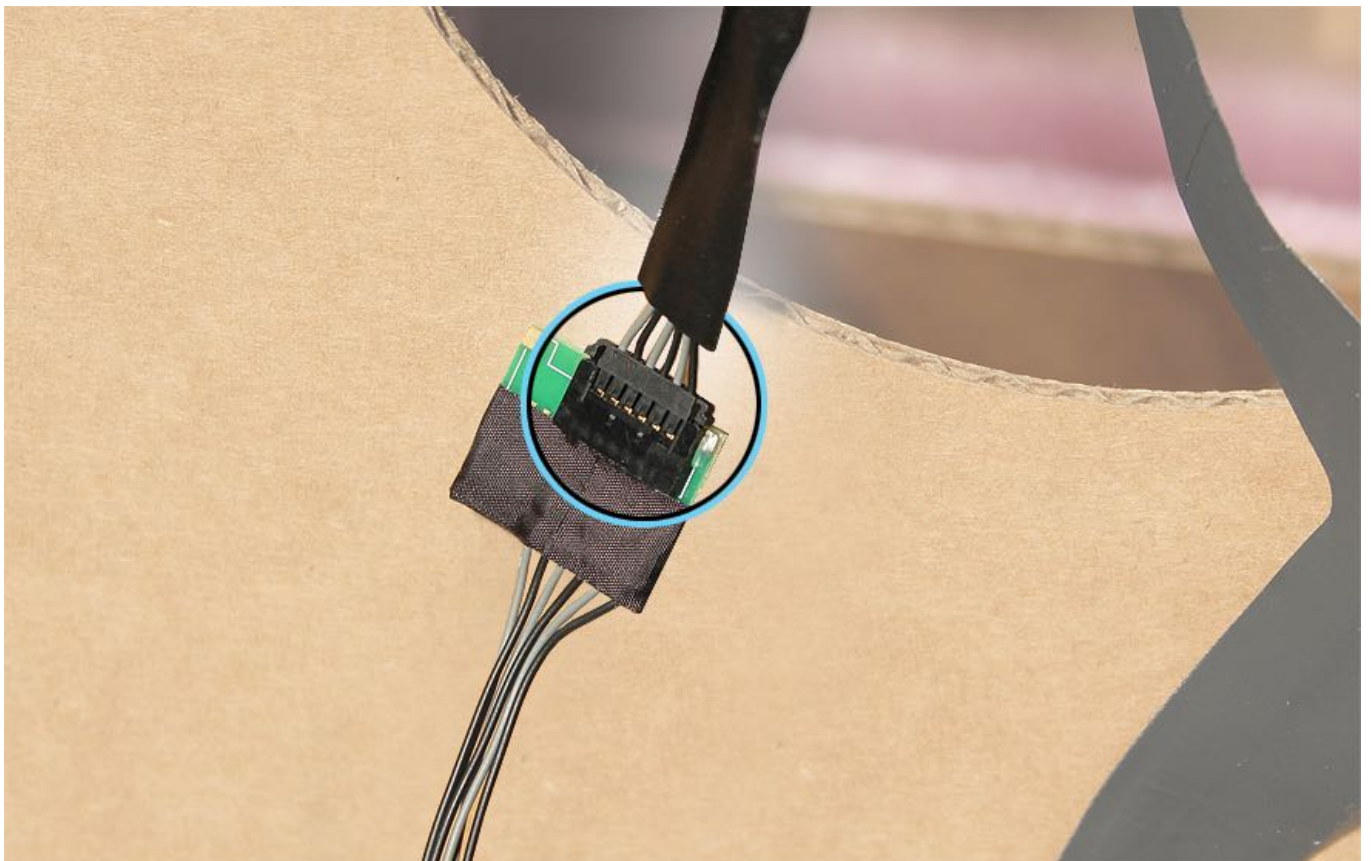
13. With the iMac unplugged, connect the backlight extension cable to the backlight connector on the logic board.



14. Connect the other end of the backlight extension cable to the dangling end of the display backlight cable (1).



15. Securely mate the backlight extension cable with the panel's backlight cable connector.



16. Locate the two power supply covers. With the iMac unplugged, position one horizontally over the power supply and one vertically over the logic board and cables. Tape the power supply covers securely to the rear housing. Proper eDP and backlight extension cable setup is shown below.

17. Attach the power cord to the iMac and start up the system to verify system functionality.



## Procedure #2: Testing the Panel with the eDP Substitution Cable

This procedure tests an eDP cable to determine whether the issue is with the eDP cable. Remove the "suspect" eDP cable from the circuit and replace it with the eDP substitution cable.

### First Steps

1. Remove the display for the model you are servicing:

**Caution:** Wear lint-free gloves (922-8253) when handling an iMac (Retina 5K, 27-inch, 2020) with a nano-texture glass display. Use only the Apple polishing cloth (923-04724) to clean the nano-texture glass.

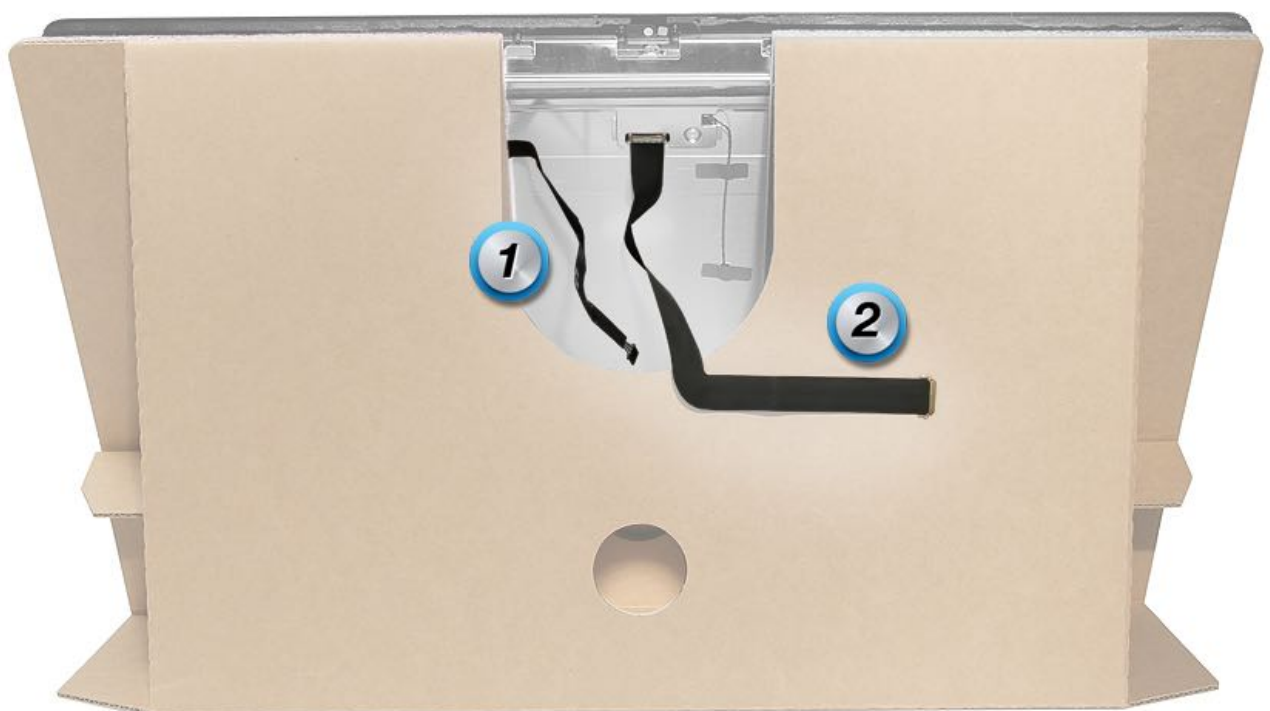
- For iMac (27-inch, Late 2012-2017):
  - [Display panel removal](#)
  - [Display panel - removing very high bond \(VHB\) strips](#)
- For iMac Pro (2017):
  - [Display panel removal](#)
  - [Display panel - removing very high bond \(VHB\) strips](#)
- For iMac (Retina 5K, 27-inch, 2019)
  - [Display removal](#) (includes display adhesive (VHB) removal)
- For iMac (Retina 5K, 27-inch, 2020)
  - [Display removal](#) (includes display adhesive (VHB) removal)

2. Place the display on the iMac LCD service support stand.



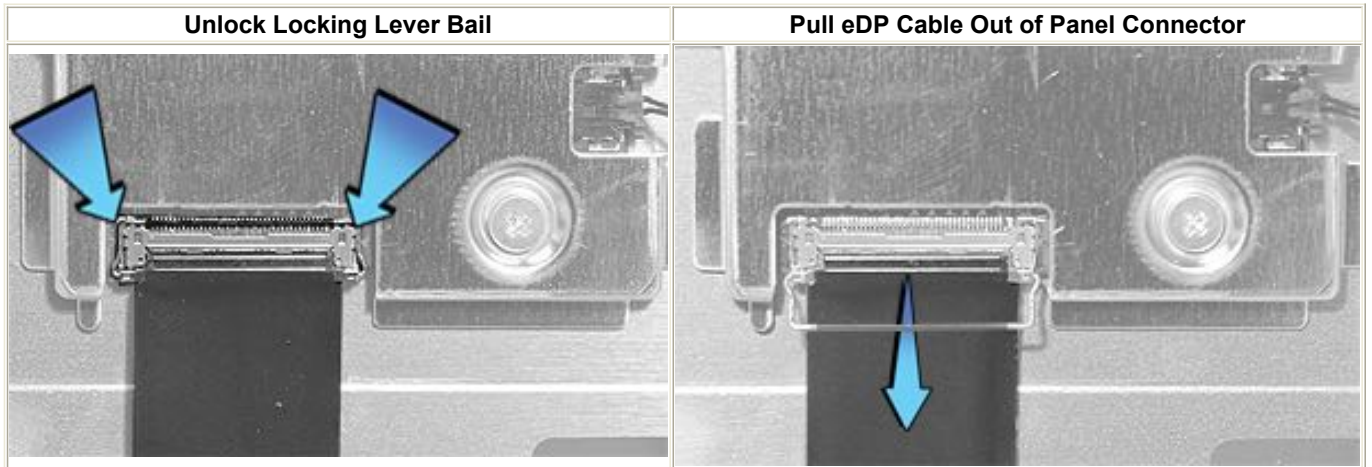


3. Orient the iMac LCD service support stand so the backlight cable (1) and the eDP (2) cable are facing you.





4. Disconnect the eDP cable from the connector on the display. Use your fingernail to flip the locking lever bail. Pull the cable out of the connector.



5. Locate the eDP substitution cable.



6. Either end of the eDP substitution cable can connect to the logic board; the other end connects to the display.

**Important:** Each end of the eDP substitution cable has a gold dot to indicate the cable orientation. Orient the cable with the gold dot side up when connecting the eDP substitution cable to the logic board and to the connector on the display. Connecting the cable upside down (with the brass connector facing you) will damage the logic board and/or the display.

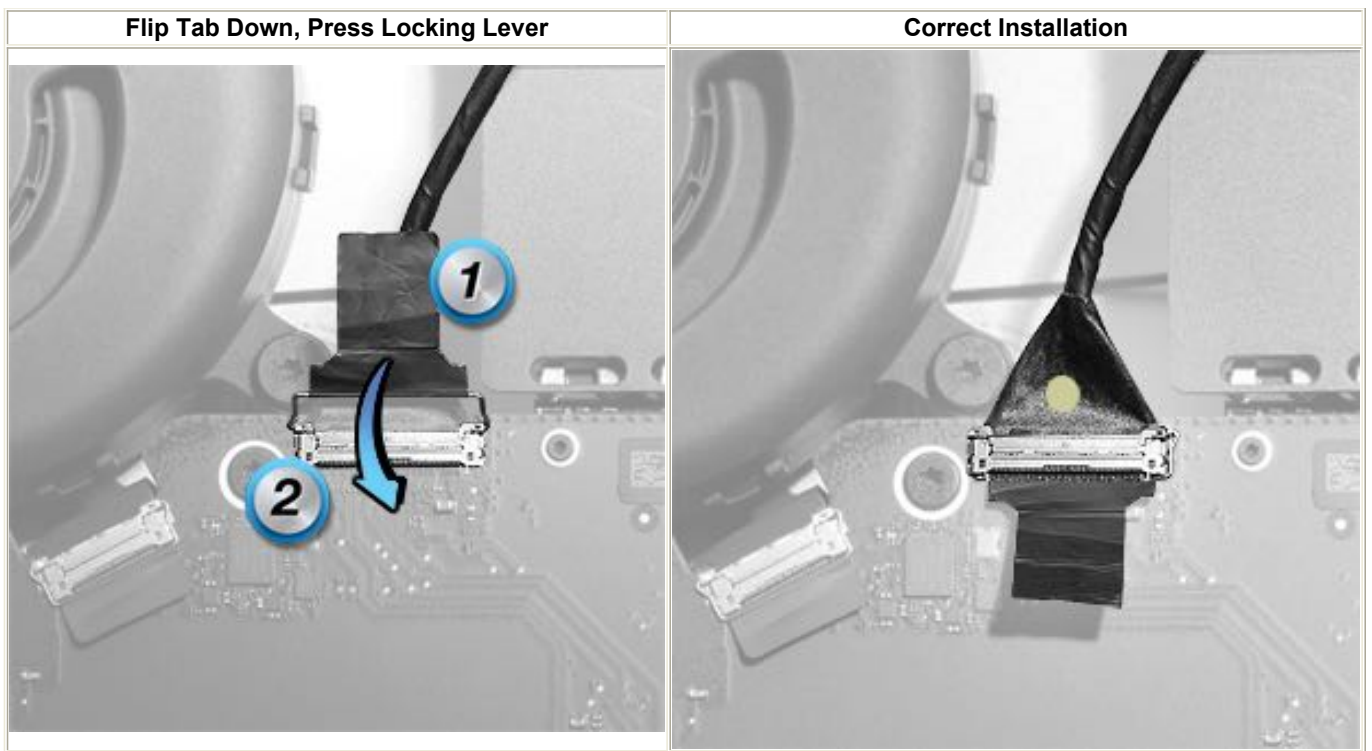
**Note:** With proper care, cables will last for approximately 50 insertions. After 50 insertions, cable degradation may occur and Apple recommends ordering a new Display Extension/Substitution Cable Kit (refer to the Tools section above).

Correct Orientation (Gold Dot Side Up)	Incorrect Orientation (Brass Side Up)
 <p>The image shows the eDP substitution cable with the gold dot side up. The cable is black with a gold dot on the top surface. The connector is visible, showing the gold contacts and the locking lever.</p>	 <p>The image shows the eDP substitution cable with the brass side up. The cable is black with a brass-colored strip on the top surface. The connector is visible, showing the brass contacts and the locking lever.</p>

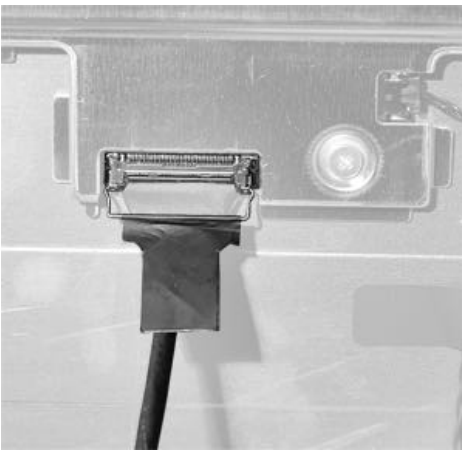
7. With the iMac unplugged, connect one end of the eDP substitution cable to the connector on the logic board. The cable should be aligned straight on with the connector and never inserted at an angle. The eDP substitution cable is shown properly connected to the logic board.

**Important:** Ensure that the black tab is attached to the locking lever on the eDP cable. Attaching the locking lever without the black tab may cause damage to the logic board and/or the display.

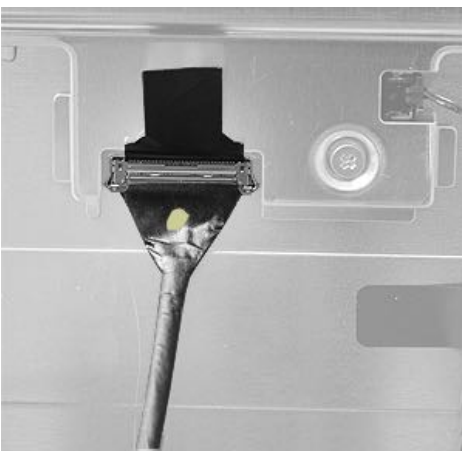
- Verify that each end of the cable has the gold dot side up.
- Check that the connector is fully seated.
- Flip the black tab down (1).
- Press the locking lever (2) to secure the cable to the logic board.



8. Connect the other end of the eDP substitution cable to the eDP connector on the back of the display.



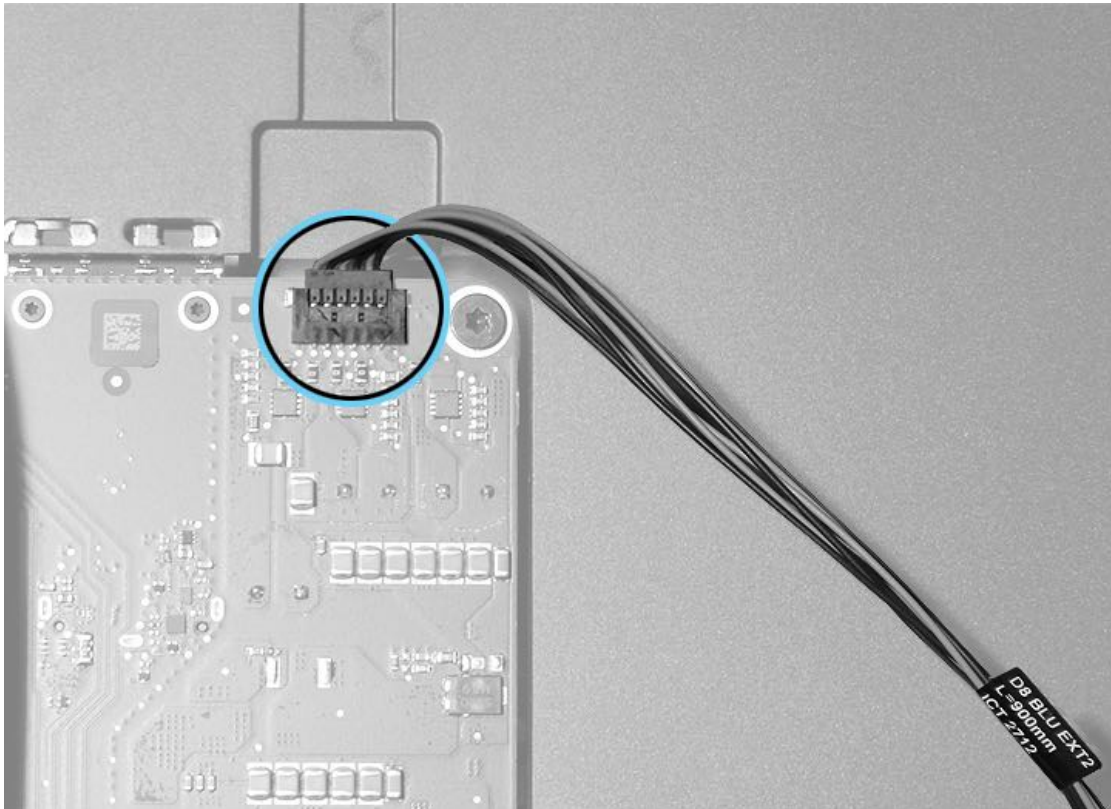
9. Flip the black tab up and press the locking lever bar to secure the cable to the connector on the panel.



10. Locate the backlight extension cable (BLC).

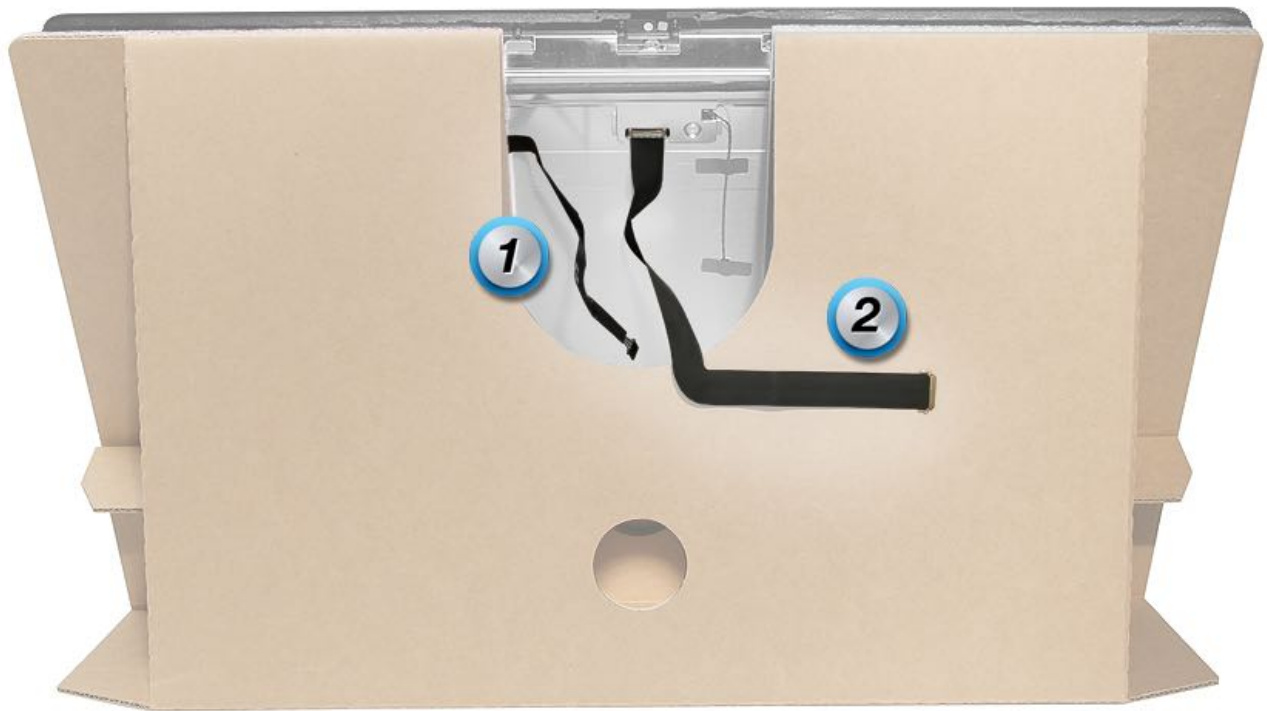


11. With the iMac unplugged, connect the backlight extension cable to the backlight connector on the logic board.

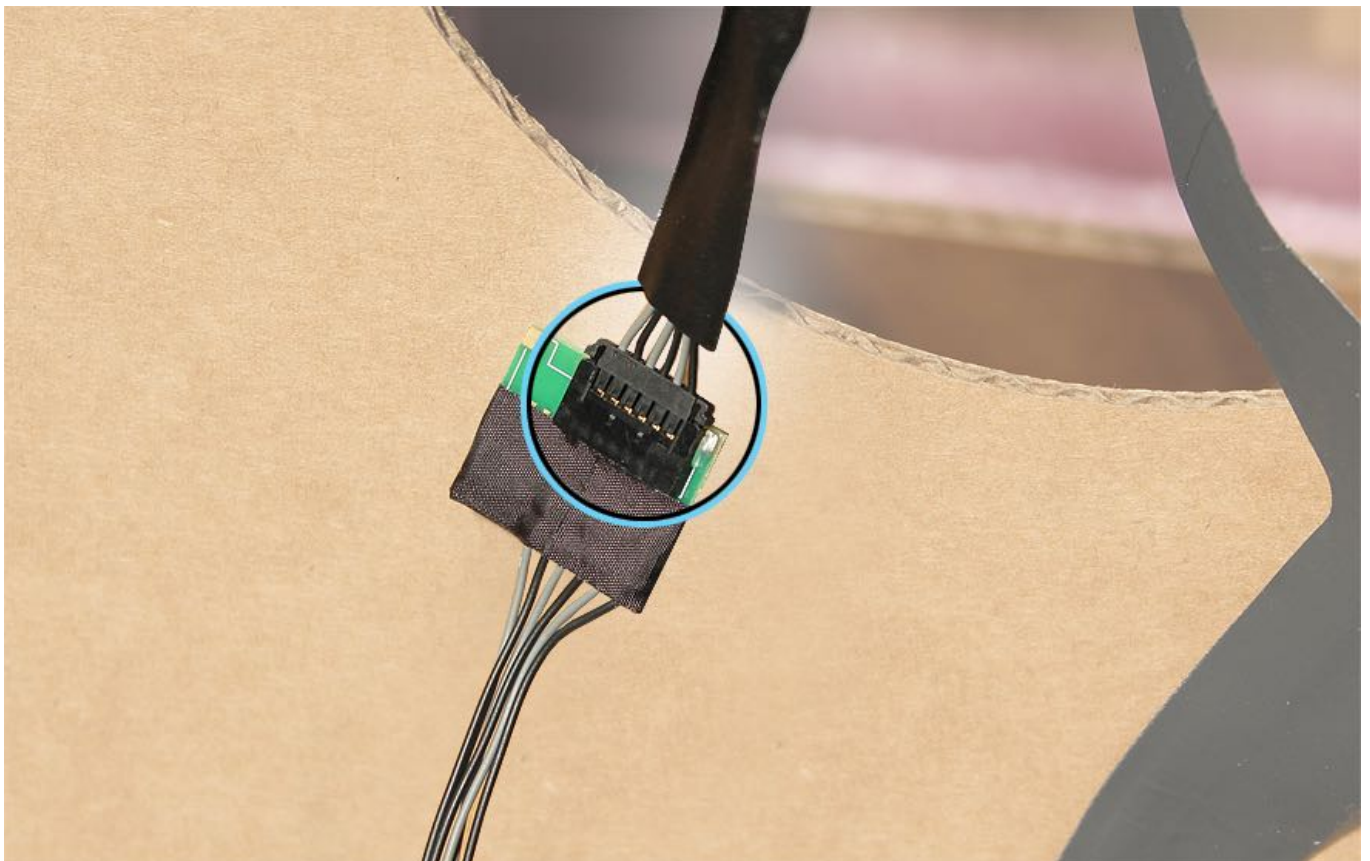


12. Connect the other end of the backlight extension cable to the dangling end of the display backlight cable (1).





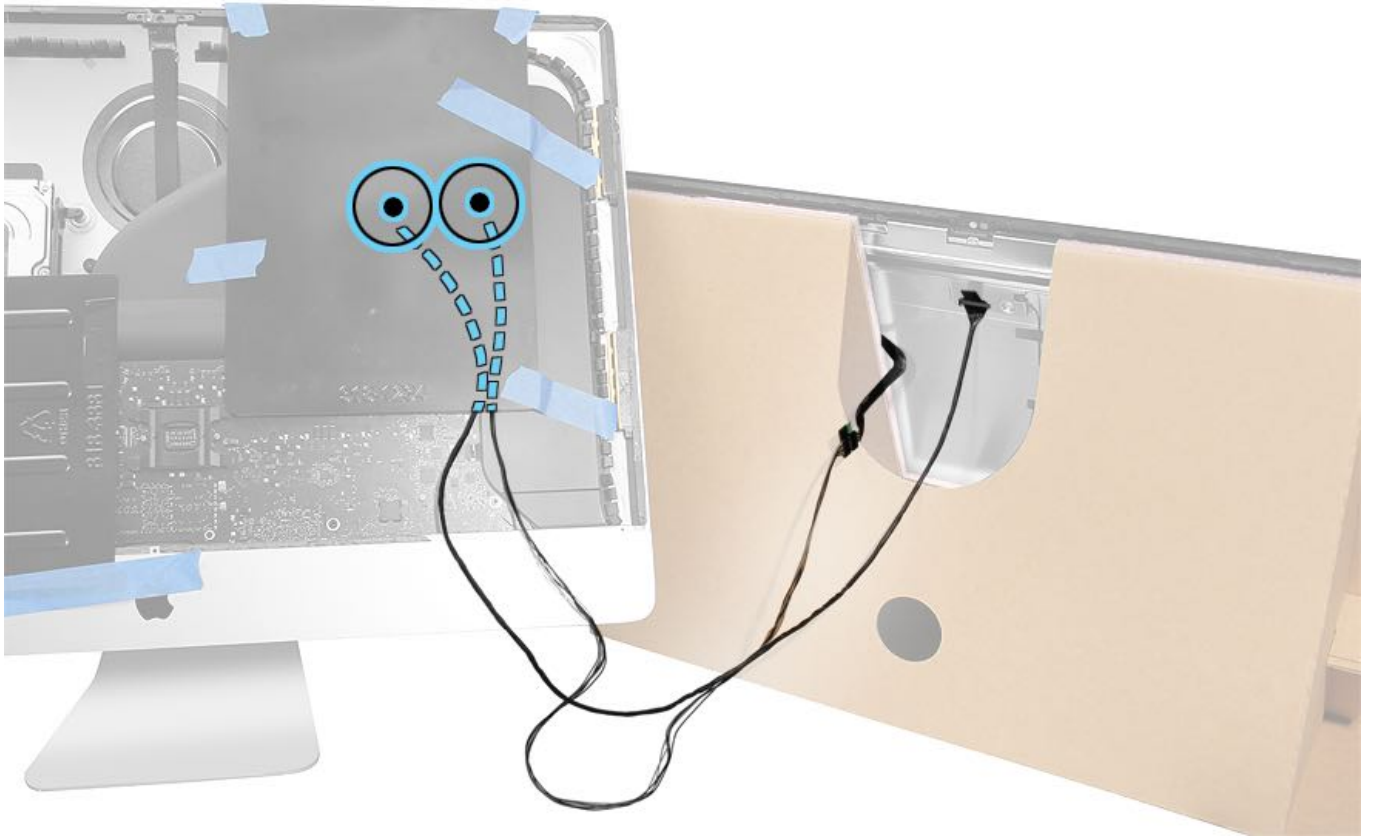
13. Securely mate the backlight extension cable with the panel's backlight cable connector.



14. Locate the two power supply covers. With the iMac unplugged, position one horizontally over the power supply and one vertically over the logic board and cables. Tape the power supply covers securely to the rear housing. The image below shows the proper cable setup for the eDP substitution cable and backlight extension cable.

15. Attach the power cord to the iMac and start up the system to verify eDP cable functionality.





# Device Firmware Update (DFU) mode for Computers with the Apple T2 Security Chip

This article documents the steps to put both a portable system and a desktop system into Device Firmware Update (DFU) mode. AST 2 System Configuration and Data Transfer Setup suites cannot be run unless the customer computer is in DFU mode. Refer to [System Configuration for Macs with the Apple T2 Security Chip](#) and [Data Transfer for Macs with the Apple T2 Security Chip](#).

## Before you begin:

- To make sure the customer's computer is connected to the host machine correctly, refer to [System Configuration for Macs with the Apple T2 Security Chip](#).

1. Press and hold the power button (Image 1), then immediately press and hold Left Control-Left Option-Right Shift (Image 2) until you see the prompt appear in Mac Configuration Utility (Image 3), which may take up to 10 seconds.  
**Note:** Use the same keys on all keyboard layouts, even though the placement of the keys may be different on JIS and ISO keyboards.

Image 1



Image 2



Image 3



**For iMac Pro and iMac (Retina 5K, 27-inch, 2020):**

1. Press and hold the power button on the rear enclosure (Image 1) and connect the power cord (Image 2).

**Image 1**



**Image 2**



2. Continue to hold the power button until you see the prompt appear in Mac Configuration Utility, which may take up to 10 seconds.





**For Mac mini (2018):**

1. Press and hold the power button on the enclosure (Image 1) and connect the power cord (Image 2).

**Image 1**





Image 2



2. Continue to hold the power button until you see the prompt appear in Mac Configuration Utility, which may take up to 10 seconds.



**For Mac Pro (2019):**

1. Press and hold the power button (Image 1) and connect the power cord (Image 2).

**Image 1**



**Image 2**



2. Continue to hold the power button until you see the prompt appear in Mac Configuration Utility, which may take up to 10 seconds.



**For Mac Pro (Rack, 2019):**

1. Press and hold the power button (Image 1) and connect the power cord (Image 2).

**Image 1**



**Image 2**







2. Continue to hold the power button until you see the prompt appear in Mac Configuration Utility, which may take up to 10 seconds.





# Bluetooth Device Connection Issues

## Unlikely causes:

Battery, camera/microphone/ALS cable, fan, DisplayPort cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, flash storage card, stand.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Bluetooth cannot be enabled.</li><li>Bluetooth is not detected or available in System Information.</li><li>Bluetooth can be turned on, but the computer is unable to pair with a known-good Bluetooth device.</li><li>Intermittent loss of communication with paired Bluetooth device.</li><li>Data transfer over Bluetooth times out or is too slow.</li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>In System Preferences &gt; Bluetooth, check that Bluetooth is on.</li><li>Attempt to pair the computer with a known-good Bluetooth keyboard, mouse, or trackpad.</li><li>Reset the Bluetooth device or delete the pairing (if applicable).</li><li>Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to verify system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li><li>If the customer is using a USB 3 device, review <a href="#">HT201163: About USB on Mac computers</a> to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.</li><li>If the user's computer pairs Bluetooth normally at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to <a href="#">HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference</a>.</li><li>Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>Reset the SMC using the procedure for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li><a href="#">TP833: Power Supply Cover Instructions</a></li><li><a href="#">TP820: iMac (27-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li><a href="#">TP1620: Power Supply Cover Instructions</a></li><li><a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Check Mac Resource Inspector diagnostic suite (MRI) test results or System Information &gt; Hardware &gt; USB device tree to verify that the Bluetooth controller is listed.</p> <p>Is Bluetooth hardware detected?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M36	MLB
2.	<p>Open System Preferences &gt; Bluetooth. Remove all paired devices. Pair the computer with a known-good Bluetooth device.</p> <p>Does the computer pair with a known-good Bluetooth device?</p>	Yes	Go to the “External Apple Bluetooth Peripherals” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	<p>Start up the computer to Internet Recovery. See <a href="#">HT201314: About macOS Recovery</a>.</p> <p>Connect to a known-good Bluetooth device. Compare Bluetooth performance and reliability to a known-good computer of similar type and Bluetooth specification.</p> <p>Is the pairing issue resolved and is Bluetooth performance as expected?</p>	Yes	<p>Reinstall macOS on the user’s computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
	<p>Follow Service Guide procedures to remove the display panel to gain access to the wireless antenna connectors on the logic board.</p> <p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Remove the display panel.</p> <p>Locate the Bluetooth antenna, and inspect antenna's cable and connector for any damage.</p> <p>Antenna identification callouts are as follows (refer to diagram):</p> <ol style="list-style-type: none"> <li>1. Wi-Fi (Apple logo)</li> <li>2. Wi-Fi and Bluetooth (top)</li> <li>3. Wi-Fi (upper side)</li> <li>4. Wi-Fi (lower side)</li> </ol> <p><u>iMac Pro (2017)</u></p>	Yes	Go to step 5.	\$_{nodeText.yesSymptomCode}	
4.	<p><u>iMac (Retina 5K, 27-inch, 2020)</u></p> <p>Are antenna cable and connector in good condition?</p>	No	<p>Replace the Bluetooth antenna.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
5.	<p>Locate the Bluetooth antenna connector on the logic board.</p> <p>Disconnect the Bluetooth antenna cable from the logic board. Verify that the logic board antenna connector is not damaged, loosened, or unsoldered.</p> <p>Reseat antenna cable to logic board. Verify connection is secure and correctly aligned.</p> <p><b>Note:</b> Follow all service guide procedures and use the appropriate antenna removal tool and wireless card support tool when working with antenna cables. Failure to do so may result in logic board damage.</p> <p>Is Bluetooth antenna connector in good condition and securely seated?</p>	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
6.	<p>Connect an external display and try to pair with a known-good Bluetooth device.</p> <p>Did computer pair successfully with known-good Bluetooth device?</p>	Yes	Issue resolved by reseating Bluetooth antenna. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 7.	\${nodeText.noSymptomCode}	
7.	<p>The Bluetooth antenna is located on upper edge of the enclosure and is available as a standalone part.</p> <p>Do you have immediate access to a known-good Bluetooth antenna?</p>	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the Bluetooth antenna.</p> <p>Verify that the issue is resolved.</p>	X03	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
8.	Substitute known-good Bluetooth antenna. Connect an external display and try to pair with a known-good Bluetooth device.  Did computer pair successfully with known-good Bluetooth device?	Yes	Replace the Bluetooth antenna.  Verify that the issue is resolved.	X03	OTHER ELECTRIC
		No	Reinstall user's Bluetooth antenna.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M36	MLB
9.	Pair with a known-good Bluetooth device and verify that the connection is sustained for several minutes.  Run AST 2 Full System Diagnostic (EFI & OS), if available, to ensure no other issues remain.  Verify that the issue is resolved.  Is the issue resolved?	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multiple-part repair.	X99	



# Ethernet Issues

## Unlikely causes:

AirPort/Bluetooth antenna(s), battery, camera, camera/microphone/ALS cable or camera cable, CPU fan, eDP cable, hard disk drive (HDD) (some models), hard drive data or power or combo cable (some models), display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid state drive (SSD)/flash storage card, stand, wireless card (some models)

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• No Ethernet device present.</li><li>• Unable to access Ethernet network resources.</li><li>• Ethernet device shows no connection.</li><li>• Ethernet device unable to get an IP address.</li><li>• Slow Ethernet network performance.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Verify the network setup by accessing it directly via a known-good computer's Ethernet port.</li><li>2. Launch System Information. Verify that the computer's Ethernet port appears in the Network devices tree.</li><li>3. Test with known-good network hardware and an Ethernet cable (Cat-5 or better is recommended for 100+ Mbps connections).</li><li>4. Using known-good network hardware and cable, start up from a known-good, up-to-date macOS volume. Go to Network Utility &gt; Info and verify that Link Status is "Active."</li><li>5. Check network settings. If a known-good DHCP server is available, set System Preferences &gt; Network &gt; Ethernet to Using DHCP. Verify the IP address. (If it begins with 169.x.x.x, the system was unable to get a valid IP address.)</li><li>6. When started up from user's OS, revert to default network settings by creating a new location in System Preferences &gt; Network.</li><li>7. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to verify system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li><li>8. Run AST 1 or AST 2 Mac Resource Inspector (MRI) and check results to verify that Ethernet hardware is detected.</li><li>9. If AST 1 or AST 2 is not available, use System Information to verify that Ethernet hardware is recognized.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li><li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Inspect the Ethernet port for dust, debris, damage, or bent pins. Use compressed air to remove debris. Plug in a known-good Ethernet cable and verify all pins make physical contact with connector.</p> <p>Are any Ethernet port pins damaged or insufficiently contacting the known-good Ethernet connector?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
2.	<p>Inspect logic board, Ethernet port, and enclosure for dents, scratches, or other indications of impact or abuse.</p> <p>Does accidental damage appear to be cause of issue?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M10	MLB
3.	<p>Inform user that computer failures due to accidental damage are not covered under any Apple warranty, including AppleCare. If applicable, discuss out-of-warranty repair options.</p> <p>Does user want to proceed with out-of-warranty repair?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M10	MLB
		No	<p>Issue resolved. Return computer to user using correct positioning.</p>	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	Ensure that the user's computer is connected to the Internet using a known-good Ethernet cable, and that Wi-Fi is turned off so that all network traffic goes through built-in Ethernet.  Start up the computer to Internet Recovery. See <a href="#">HT201314: About macOS Recovery</a> .  Open Safari and attempt to access a known-good external web page such as <a href="http://www.apple.com">www.apple.com</a> to verify Ethernet connectivity. Look for the web page to load, or for a timeout indicating that the page did not load.  Are Ethernet network resources accessible starting from a known-good macOS?	Yes	Reinstall macOS on the user's computer.  Check for and apply the latest software and firmware updates.  Verify that the issue is resolved.	\$(nodeText.yesSymptomCode)	
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	Restart the user's computer to the built-in macOS boot volume.	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
	In System Preferences > Network > Ethernet, verify that the link status is Connected (green dot) and that a valid IP address is listed. Connect the computer to an Ethernet network with a known-good DHCP server. Verify static DHCP maps or filtering are not preventing address allocation.  <b>Note:</b> DHCP allocation may not be instantaneous, depending on network. Retest.  Is Ethernet link status active?	No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M10	MLB
6.	Go to System Preferences > Network > Ethernet and obtain router IP address. Use Network Utility to ping router IP address. Use a simple hub/switch environment.  Is Network Utility able to ping router IP address?	Yes	No performance or connectivity issues detected. No repair necessary. The problem may be the network environment. Refer user to <a href="#">TS1317: Troubleshooting a cable modem, DSL, or LAN Internet connection</a> .	\$(nodeText.yesSymptomCode)	
		No	Go to step 7.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	Perform network testing from previous step, using same cable and network, but with a known-good computer.  Is network performance of user's computer inferior to known-good computer?	Yes	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M10	MLB
		No	No performance or connectivity issues detected. No repair necessary. The problem may be the network environment. Refer user to <a href="#">TS1317: Troubleshooting a cable modem, DSL, or LAN Internet connection</a> .	\${nodeText.noSymptomCode}	
8.	1. Connect Ethernet cable to a known-good network with a DHCP server. 2. In System Preferences > Network > Ethernet, verify link status is Connected (green dot). 3. Configure TCP/IP settings to Using DHCP and check that a valid IP address is obtained from server (not a self-assigned one starting with 169.x.x.x). 4. Launch web browser and verify that you can access websites and download files.  Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.  Verify that the issue is resolved.  Is issue resolved?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	M99	

# Wi-Fi Connection Issues

## Unlikely causes:

Battery, camera/microphone/ALS cable, DisplayPort cable, fan, flash storage card, display panel, left speaker, memory, power supply, right speaker, stand.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Wi-Fi service not available.</li><li>• Cannot turn Wi-Fi on</li><li>• Wi-Fi can be turned on, but cannot connect to known-good Wi-Fi network.</li><li>• Intermittent loss of Wi-Fi communication.</li><li>• Poor Wi-Fi signal.</li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. In System Preferences &gt; Network, check that Wi-Fi is on.</li><li>2. Attempt to connect the computer to a known-good Wi-Fi network.</li><li>3. Create a new network location in System Preferences.</li><li>4. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model. Using Ethernet network interface, connect to the Internet, then check for and apply latest software and firmware updates.</li><li>5. If the customer is using a USB 3 device, review <a href="#">HT201163: About USB on Mac computers</a> to identify possible interference with Wi-Fi and Bluetooth communications if the device is positioned near their antennas.</li><li>6. If the user's computer connects normally to Wi-Fi at your service location, research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to <a href="#">HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference</a>.</li><li>7. Refer to <a href="#">HT202663: If your Mac doesn't connect to the Internet over Wi-Fi</a> to familiarize yourself with the macOS Wireless Diagnostic utility.</li><li>8. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>9. Reset the SMC using the procedure for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive



	Check	Result	Action	Code
1.	<p>Check Mac Resource Inspector diagnostic suite (MRI) test results or System Information &gt; Network &gt; Wi-Fi to verify that the wireless module is listed.</p> <p>Is Wi-Fi hardware detected?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M35
2.	<p>Run Wireless Diagnostics by holding down the Option key, clicking the wireless icon in the menu bar, and then choosing Open Wireless Diagnostics.</p> <p>Wireless Diagnostics can also be found at: /System/Library/CoreServices/Applications/WirelessDiagnostics.app</p> <p>Does the computer complete Wireless Diagnostics with no issues?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`
		No	Go to step 4.	`\${nodeText.noSymptomCode}`
3.	<p>Connect to a known-good wireless network and open Wireless Diagnostics &gt; Window &gt; Performance. Review the quality graph to evaluate the signal quality of the wireless connection. Verify that the signal is good or excellent, and that the transmission rate (Tx Rate) is comparable to another known-good computer of similar type and Wi-Fi specification. Where available, switch between 2.4GHz and 5GHz networks to verify that the signal quality is comparable to a known-good computer.</p> <p>Using a network with a high transmission rate, download a large file from a known-good website or file server. Compare network performance to another known-good computer of similar type and Wi-Fi specification. Verify throughput using Activity Monitor &gt; Network.</p> <p>Are the performance and throughput comparable between the user's computer and a known-good computer?</p>	Yes	Wi-Fi performance is within specification. Verify that the issue is resolved.	`\${nodeText.yesSymptomCode}`
		No	Go to step 4.	`\${nodeText.noSymptomCode}`
4.	<p>Start up the computer to Internet Recovery. See <a href="#">HT201314: About macOS Recovery</a>.</p> <p>Attempt to reproduce the Wi-Fi performance or connection issue.</p> <p>Does the issue persist with known-good macOS?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`
		No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`

	Check	Result	Action	Code
5.	<p>Follow Service Guide procedures to remove the display panel to gain access to the wireless antenna connectors on the logic board.</p> <p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Remove the display panel.</p> <p>Locate the three Wi-Fi antennas and inspect each antenna's cable and connector for any damage.</p> <p>Antenna identification callouts are as follows (refer to diagram):</p> <ol style="list-style-type: none"> <li>1. Wi-Fi (Apple logo)</li> <li>2. Wi-Fi and Bluetooth (top)</li> <li>3. Wi-Fi (upper side)</li> <li>4. Wi-Fi (lower side)</li> </ol> <p><u>iMac Pro (2017)</u></p>	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`
	<p>Are Wi-Fi antenna cables and connectors in good condition?</p> <p><u>iMac (Retina 5K, 27-inch, 2020)</u></p>	No	Go to step 6.	`\${nodeText.noSymptomCode}`

	Check	Result	Action	Code
6.	<p>Check the Service Guide to verify whether affected Wi-Fi antenna is available separately as a service part.</p> <p>Is Wi-Fi antenna available as service part?</p>	Yes	<p>Replace the affected Wi-Fi antenna.</p> <p>Verify that the issue is resolved.</p>	X03
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>The antenna is part of the rear housing. Replace the rear housing. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>Contact CSS for additional support regarding warranty coverage for this part.</p>	X99
7.	<p>Locate the Wi-Fi antenna connectors on the logic board.</p> <p>Disconnect the Wi-Fi antenna cables from the logic board. Verify that the logic board antenna connectors are not damaged, loosened, or unsoldered.</p> <p>Reseat antenna cables to logic board. Verify connection is secure and correctly aligned.</p> <p><b>Note:</b> Follow all service guide procedures and use the appropriate antenna removal tool and wireless card support tool when working with antenna cables. Failure to do so may result in logic board damage.</p> <p>Are Wi-Fi antenna connectors in good condition and securely seated?</p>	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24
8.	<p>Connect external display and retest. Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Is the issue resolved?</p>	Yes	Wi-Fi performance is within specification. Verify issue resolved.	`\${nodeText.yesSymptomCode}`
		No	Go to step 9.	`\${nodeText.noSymptomCode}`
9.	<p>To troubleshoot this issue completely, a set of known-good Wi-Fi antennas is required.</p> <p><b>Note:</b> Some Wi-Fi antennas are part of the rear housing and are not separately replaceable.</p> <p>Do you have immediate access to a set of known-good Wi-Fi antennas?</p>	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`
		No	Go to step 12.	`\${nodeText.noSymptomCode}`

	Check	Result	Action	Code
10.	Substitute known-good Wi-Fi antenna.	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`
	Connect external display and retest. Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.	No	Go to step 12.	`\${nodeText.noSymptomCode}`
	Verify that wireless connection is sustained for several minutes.			
	Repeat with other antennas.			
	Is the issue resolved?			
11.	Verify whether affected Wi-Fi antenna is available separately as a service part.  Is Wi-Fi antenna available as service part?	Yes	Replace the affected Wi-Fi antenna.  Verify that the issue is resolved.	X03
		No	<b>ESCALATION REQUIRED.</b>  The antenna is part of the rear housing. Replace the rear housing. Verify issue resolved.	X99
			Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> .	
			Contact CSS for additional support regarding warranty coverage for this part.	
12.	Reinstall the user's Wi-Fi antenna if it was removed during troubleshooting.	Yes	Replace the logic board.	M40
	Determine if the following symptom was observed on the user's computer:		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.	
	<ul style="list-style-type: none"> <li>No Wi-Fi signal.</li> </ul>		Verify that the issue is resolved.	
	Does this symptom accurately describe the user's issue?	No	Go to step 13.	`\${nodeText.noSymptomCode}`

	Check	Result	Action	Code
13.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> <li>Cannot connect to a known-good Wi-Fi network.</li> </ul> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M41
		No	Go to step 14.	\${nodeText.noSymptomCode}
14.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> <li>Onboard Wi-Fi Performance issue.</li> </ul> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M42
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99
15.	<p>Connect to a known-good wireless network and retest data throughput, checking for adequate transfer speeds.</p> <p>Verify that wireless connection is sustained for several minutes.</p> <p>Run AST 2 Full System Diagnostic (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99



# Backlight Issue or No Backlight

## Unlikely causes:

Wireless antennas, battery, camera, camera/microphone/ALS cable, fan, left speaker, memory, power supply, rear enclosure, right speaker, flash storage card, stand.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Display not illuminated.</li><li>• Flickering, unstable, or non-uniform backlight.</li><li>• Poor backlight at some or all settings.</li><li>• Display backlight fails after warmup.</li><li>• Display backlight fails at certain brightness settings.</li><li>• Unit appears to turn on and operate, but no image is seen on the display.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to verify system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li><li>2. Cover ambient light sensor to mimic a dark room and adjust brightness to maximum setting using F2 key on wired keyboard.</li><li>3. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>4. Reset the SMC using the procedure for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>.</li><li>5. Put the computer to sleep by pressing Control-Shift-Eject. Wake it by pressing any key.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a compatible external display. Check to see whether the external display mirrors the backlight issue or shows any video at all.  Does external display show a video signal of any kind?	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	If no image appears on the display, then return to the list of symptoms and select “Power But No Video” from the troubleshooting menu.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
2.	<p>Run AST 2 Mac Resource Inspector diagnostic suite (MRI). Review MRI results or System Information &gt; Graphics/Displays. Look for information indicating internal display presence in results.</p> <p>Does MRI detect the display?</p>	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
		No	If no image appears on the display, then return to the list of symptoms and select “Power But No Video” from the troubleshooting menu.	\$(nodeText.noSymptomCode)	
3.	<p>Shine bright (low-heat) flashlight onto front of display panel. With computer turned on, verify whether a faint image is visible.</p> <p>Does display show a video signal despite not being backlit?</p>	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	If no image appears on the display, then return to the list of symptoms and select “Power But No Video” from the troubleshooting menu.	\$(nodeText.noSymptomCode)	
4.	<p>Follow Service Guide procedures to remove the display panel.</p> <p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Remove the display panel.</p> <p>Inspect display power cable and its connectors between logic board and display panel.</p> <p>Is the cable damaged?</p>	Yes	<p>Replace the display panel, which includes the display power cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L09	LCD
		No	Go to step 5.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
5.	Reseat display power cable between logic board and display panel. Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.  Warning: Be extremely careful when working inside the computer when power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.  For additional safety information and tips, refer to: <ul style="list-style-type: none"> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>	Yes	Issue resolved by reseating display power cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	
6.	<b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.  Remove display panel and inspect eDP cable for misrouting. Disconnect eDP cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.  Is the cable or its connector damaged?	Yes	Replace the embedded DisplayPort (eDP) cable.  Verify that the issue is resolved.	X03	INTERNAL CABLE
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	Keep eDP cable disconnected from logic board. Inspect eDP connector on the logic board for damaged or bent pins.  Is logic board cable connector damaged?	Yes	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M24	MLB
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
8.	Test the logic board backlight fuse with a multimeter. For information about using a multimeter, see <a href="#">HT3250: Using a digital multimeter</a> .	Yes	Replace the logic board.	M25	MLB
	Refer to the Service Guide Functional Overview for information about locating backlight fuse.		Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.		
	Locate backlight fuse on the logic board. Be careful not to scratch or knock nearby components off the logic board when using the multimeter probes.	No	Go to step 9.	{\$nodeText.noSymptomCode}	
	Set the multimeter to measure ohms ( $\Omega$ ). Place the multimeter probes on each side of the fuse that is soldered to the logic board. The multimeter should measure between zero and one ohm.				
9.	Does the multimeter show a reading greater than 1 $\Omega$ ?	Yes	Issue resolved by reseating embedded DisplayPort (eDP) cable. Verify issue resolution.	{\$nodeText.yesSymptomCode}	
	Reseat the eDP cable between display panel and logic board.				
	<b>Warning:</b> Be extremely careful when working inside the computer when power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.	No	Go to step 10.	{\$nodeText.noSymptomCode}	
	Is normal video restored?				
10.	Troubleshooting this issue completely requires a known-good eDP cable.	Yes	Go to step 11.	{\$nodeText.yesSymptomCode}	
	The iMac Display Extension Cable Kit contains an eDP substitution cable that can be used for testing.				
	Refer to <a href="#">TP981: Testing the Panel Using the Display Extension Cable Kit</a> for information about how to use extension cables.	No	Replace the embedded DisplayPort (eDP) cable.	X03	INTERNAL CABLE
	Do you have immediate access to a known-good eDP cable?				
			Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
11.	<b>Important:</b> Ensure that user's computer is shut down, then remove the power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.  Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.	Yes	Replace the embedded DisplayPort (eDP) cable.  Verify that the issue is resolved.	X03	INTERNAL CABLE
		No	Go to step 12.	\${nodeText.noSymptomCode}	
	Is normal video restored?				
12.	Troubleshooting this issue completely requires a known-good display panel.  Do you have immediate access to a known-good display panel?	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
		No	Replace the display panel.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	L09	LCD



	Check	Result	Action	Code	Commodity
13.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L09	LCD
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M25	MLB
14.	<p>Restart the computer and verify that the display backlight is fully functional.</p> <p>Run AST 2 Full System Diagnostic (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	`\${nodeText.noSymptomCode}`	

# Display Anomalies

## Unlikely causes:

Battery, camera (some models), camera/microphone/ALS cable or camera cable, fan, flash storage card/solid-state drive (SSD), hard disk drive (HDD) (some models), hard drive data or power or combo cable (some models), left speaker, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> <li>• Distorted or blurred image</li> <li>• Pixel anomalies</li> <li>• Vertical/horizontal lines</li> <li>• Unstable flickering</li> <li>• Incorrect or missing colors</li> <li>• Nonuniform brightness at specific location</li> <li>• Vertical lines of nonuniform brightness repeating over the display</li> <li>• Image persistence or image sticking on screen</li> <li>• Light leakage around the display</li> </ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p>References to the “Test Patterns Tool (TPT)” diagnostic in this procedure are intended for all iMac models introduced before 2014 that are supported by AST 1. For iMac models introduced in 2014 and later, use the “Display Anomalies” diagnostic that is supported by AST 2.</p> <p><b>Important:</b> Follow instructions in <a href="#">TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays</a> to identify conditions that affect warranty and service eligibility.</p> <p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"> <li>1. Compare an image on user’s display with the same image on an equivalent, known-good computer display. Small variations in display quality are normal and expected and may not indicate a service issue.</li> <li>2. Clean the glass panel and check for dust or debris.</li> <li>3. Check the brightness setting.</li> <li>4. Verify that System Preferences &gt; Universal Access &gt; Seeing &gt; Enhance Contrast is set to Normal.</li> <li>5. Check System Preferences &gt; Displays &gt; Color for possible use of a custom display profile. Set profile to Color LCD.</li> <li>6. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See <a href="#">HT201314: About macOS Recovery</a>.</li> <li>7. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates, especially those that deal with display or graphic issues.</li> <li>8. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li> <li>9. Reset the SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>.</li> <li>10. Some iMac displays support True Tone. The color adjustments made by TrueTone could be mistaken for service issues. Refer to <a href="#">HT208909: Use True Tone on your Mac</a> for more information about True Tone displays.</li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP833: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model:	A	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	A. iMac Pro (2017), or other iMacs with the T2 Security Chip B. iMacs without the T2 Security Chip  Refer to <a href="#">HT208862: About the Apple T2 Security Chip</a> for more information.  Which iMac model?	B	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	Follow steps in <a href="#">Revive or restore Mac firmware in Apple Configurator 2</a> to revive the T2 firmware on the user's computer.	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	Restart the computer and verify that it completely starts up to macOS.  Retest for display issue.  Does the issue persist after restoring T2 firmware?	No	The issue was resolved by restoring T2 firmware.	`\${nodeText.noSymptomCode}`	
3.	Start up the computer to a known-good external macOS startup volume.  Retest for display issue.  Does the issue persist with a known-good macOS?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Reinstall macOS on the user's computer.  Check for and apply the latest software and firmware updates.  Verify that the issue is resolved.	`\${nodeText.noSymptomCode}`	
4.	Use the Display Anomalies test suite in AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.	Yes	Go to "Unstable Flickering" troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
	Of the eight issues below, determine if "unstable flickering" best describes the primary symptom: <ul style="list-style-type: none"> <li>• <b>Unstable flickering</b></li> <li>• Distorted/blurred image</li> <li>• Vertical/horizontal lines</li> <li>• Pixel anomalies</li> <li>• Nonuniform brightness</li> <li>• Incorrect or missing colors</li> <li>• Light leakage around the display</li> <li>• Image persistence or image sticking on screen</li> </ul> Is unstable flickering the primary display issue?	No	Go to step 5.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.  Of the seven issues below, determine if "distorted/blurred image" or "unstable flickering" best describes the primary symptom:  <ul style="list-style-type: none"> <li>• <b>Distorted/blurred image</b></li> <li>• Vertical/horizontal lines</li> <li>• Pixel anomalies</li> <li>• Nonuniform brightness</li> <li>• Incorrect or missing colors</li> <li>• Light leakage around the display</li> <li>• Image persistence or image sticking on screen</li> </ul> Is the primary issue distortion or blurring of the display image?	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 18.	`\${nodeText.noSymptomCode}`	
6.	Connect a compatible external display.  Does image on external display appear distorted or blurred?	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 12.	`\${nodeText.noSymptomCode}`	
7.	A distorted or blurred image may be related to a failing memory module. Watch closely during startup sequence for exact point at which issue starts to occur.  Does issue occur BEFORE or AFTER Apple logo and spinning gear appears?	Before	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		After	Go to step 8	`\${nodeText.noSymptomCode}`	
8.	Start the computer in Safe Mode.  To start up into Safe Mode, follow steps listed in <a href="#">HT201262: How to use safe mode on your Mac</a> .  Does issue still occur in Safe Mode?	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	Some models have RAM modules that are directly connected to the MLB. You are unable to remove the RAM on these models.  Are you able to remove RAM modules?	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 12.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
10.	Follow Service Guide procedures to open the computer and remove installed memory. Substitute one by one with a known-good memory module. Refer to <a href="#">HT201191: Install memory in an iMac</a> for instructions.	Yes	Replace memory module.  <b>Note:</b> Only replace defective memory module. There is no need to replace memory in pairs.  Verify that the issue is resolved.	X06	MEMORY
	Depending on computer model, this may simply require removal of the rear door, or the removal of display panel and logic board to access the memory modules. Reassemble and retest.  <b>Note:</b> Always have at least the minimum amount of memory installed to support the computer and its OS. This may mean replacing a memory module with a known-good one of larger capacity for testing. For example, you may need to replace a 1 GB module with a known-good 2 GB module to support starting into macOS.  Does issue occur only with specific memory modules?	No	Go to step 11.	\$_{nodeText.noSymptomCode}	
11.	Install a known-good memory module in one memory slot and retest. Repeat test with known-good memory for each additional memory slot, one at a time.  Does issue occur only with a specific memory slot on logic board?	Yes	Reinstall user's memory.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M04	MLB
		No	Go to step 12.	\$_{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
12.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove display panel and inspect eDP cable for misrouting. Disconnect eDP cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is the cable or its connector damaged?</p>	Yes	Go to step 13.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 15.	`\${nodeText.noSymptomCode}`	
13.	<p>Troubleshooting this issue completely requires a known-good eDP cable. The iMac Display Extension Cable Kit contains an eDP substitution cable that can be used for testing.</p> <p>Refer to <a href="#">TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit</a> or <a href="#">TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit</a> for information about how to use extension cables.</p> <p>Do you have immediate access to a known-good eDP cable?</p>	Yes	Go to step 14.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
14.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove the power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 15.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
15.	<p>Keep eDP cable disconnected from logic board. Inspect eDP connector on the logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 16.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
16.	<p>Troubleshooting this issue completely requires a known-good display panel.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 17.	<p> <code>           \${nodeText.yesSymptomCode}         </code> </p>	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L04	LCD

	Check	Result	Action	Code	Commodity
17.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components. Substitute a known-good display panel to test logic board video output.</p> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul> <p>Is normal video restored?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L04	LCD
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M04	MLB
18.	<p>Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the six issues below, determine if "vertical/horizontal lines" best describes the primary symptom:</p> <ul style="list-style-type: none"> <li>• <b>Vertical/horizontal lines</b></li> <li>• Pixel anomalies</li> <li>• Nonuniform brightness</li> <li>• Incorrect or missing colors</li> <li>• Light leakage around the display</li> <li>• Image persistence or image sticking on screen</li> </ul> <p>Is the primary issue vertical or horizontal lines?</p>	Yes	Go to step 19.	\${nodeText.yesSymptomCode}	
		No	Go to step 32.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
19.	Connect an external compatible display.	Yes	Go to step 20.	`\${nodeText.yesSymptomCode}`	
	Are vertical or horizontal lines present on external display?	No	Go to step 25.	`\${nodeText.noSymptomCode}`	
20.	Vertical or horizontal lines may be related to a failing memory module. Watch closely during startup sequence for exact point at which issue starts to occur.	Before	Go to step 25.	`\${nodeText.yesSymptomCode}`	
	Does issue occur BEFORE or AFTER Apple logo and spinning gear appears?	After	Go to step 21.	`\${nodeText.noSymptomCode}`	
21.	Start the computer in Safe Mode.	Yes	Go to step 25.	`\${nodeText.yesSymptomCode}`	
	To start up into Safe Mode, follow steps listed in <a href="#">HT201262: How to use safe mode on your Mac</a> .  Does issue still occur in Safe Mode?	No	Go to step 22.	`\${nodeText.noSymptomCode}`	
22.	Some models have RAM modules that are directly connected to the MLB. You are unable to remove the RAM on these models.	Yes	Go to step 23.	`\${nodeText.yesSymptomCode}`	
	Are you able to remove RAM modules?	No	Go to step 25.	`\${nodeText.noSymptomCode}`	
23.	Follow Service Guide procedures to open the computer and remove installed memory. Substitute one by one with a known-good memory module. Refer to <a href="#">HT201191: Install memory in an iMac</a> for instructions.  Depending on computer model, this may simply require removal of the rear door, or the removal of display panel and logic board to access the memory modules. Reassemble and retest.	Yes	Replace memory module.  <b>Note:</b> Only replace defective memory module. There is no need to replace memory in pairs.  Verify that the issue is resolved.	X06	MEMORY
	<b>Note:</b> Always have at least the minimum amount of memory installed to support the computer and its OS. This may mean replacing a memory module with a known-good one of larger capacity for testing. For example, you may need to replace a 1 GB module with a known-good 2 GB module to support starting into macOS.  Does issue occur only with specific memory modules?	No	Go to step 24.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
24.	<p>Install a known-good memory module in one memory slot and retest. Repeat test with known-good memory for each additional memory slot, one at a time.</p> <p>Does issue occur only with a specific memory slot on the logic board?</p>	Yes	<p>Reinstall user's memory.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M04	MLB
		No	Go to step 25.	#{nodeText.noSymptomCode}	
25.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove display panel and inspect eDP cable for misrouting. Disconnect eDP cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is the cable or its connector damaged?</p>	Yes	Go to step 26.	#{nodeText.yesSymptomCode}	
		No	Go to step 28.	#{nodeText.noSymptomCode}	
26.	<p>Troubleshooting this issue completely requires a known-good eDP cable. The iMac Display Extension Cable Kit contains an eDP substitution cable that can be used for testing.</p> <p>Refer to <a href="#">TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit</a> or <a href="#">TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit</a> for information about how to use extension cables.</p> <p>Do you have immediate access to a known-good eDP cable?</p>	Yes	Go to step 27.	#{nodeText.yesSymptomCode}	
		No	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
27.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove the power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p>	Yes	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 28.	\${nodeText.noSymptomCode}	
	<p>Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.</p> <p>Is normal video restored?</p>				
28.	<p>Keep eDP cable disconnected from logic board. Inspect eDP connector on the logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 29.	\${nodeText.noSymptomCode}	
29.	<p>Troubleshooting this issue completely requires a known-good display panel.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 30.	\${nodeText.yesSymptomCode}	
		No	Go to step 31.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
30.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel to test logic board video output.</p> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul> <p>Is normal video restored?</p>	Yes	Go to step 31.	<code>\${nodeText.yesSymptomCode}</code>	
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M04	MLB

	Check	Result	Action	Code	Commodity
31.	<p>Examine image on display and determine whether lines are vertical or horizontal.</p> <p>Are lines vertical or horizontal?</p>	Vertical	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L27	LCD
		Horizontal	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L26	LCD
32.	<p>Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the five issues below, determine if "pixel anomalies" best describes the primary symptom:</p> <ul style="list-style-type: none"> <li>• <b>Pixel anomalies</b></li> <li>• Nonuniform brightness</li> <li>• Incorrect or missing colors</li> <li>• Light leakage around the display</li> <li>• Image persistence or image sticking on screen</li> </ul> <p>Is the primary issue pixel anomalies?</p>	Yes	Go to step 33.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 37.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
33.	Thoroughly clean the display surface to remove any dust or debris.	Yes	The issue was resolved by cleaning the display. Verify resolution.	\${nodeText.yesSymptomCode}	
	Examine the cleaned display and try to reproduce the issue.				
	Was the issue resolved by cleaning the display?	No	Go to step 34.	\${nodeText.noSymptomCode}	
34.	Shut down the computer and examine the area of the display that is affected by the symptom under a bright light source.	Yes	Replace the display panel.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	L19	LCD
	Check that the area affected is not damaged by scratches, pits, or damage to the coating of the display.				
	Refer to <a href="#">TP1138: Visual/Mechanical Inspection (VMI) Guide for Mac Displays</a> for more information.				
	Does the display surface appear damaged?	No	Go to step 35.	\${nodeText.noSymptomCode}	
35.	Run the Display Anomalies test suite in AST or AST 2.	Yes	Go to step 36	\${nodeText.yesSymptomCode}	
	If AST or AST 2 is not available, attempt to view the affected area against a number of solid-color backgrounds. Use System Preferences > Desktop & Screen Saver > Desktop, and select "Solid Colors" under "Apple" in the left-hand column.	No	Explain to user that the display is within specifications. Do not replace the display panel. Verify resolution.	\${nodeText.noSymptomCode}	
	Is the issue verified?				



	Check	Result	Action	Code	Commodity
36.	Refer to <a href="#">HT202025: About LCD display pixel anomalies for Apple products released in 2010 and later</a> to determine whether the number of defects in display exceeds specification.	Yes	Replace the display panel.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.	L20	LCD
	Does the number of pixel anomalies exceed the specified limit?	No	Verify that the issue is resolved.  Explain to user that the display is within specifications. Do not replace the display panel. Verify resolution.	`\${nodeText.noSymptomCode}`	
37.	Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.	Yes	Go to step 38.	`\${nodeText.yesSymptomCode}`	
	Of the four issues below, determine if “nonuniform brightness” best describes the primary symptom:  <ul style="list-style-type: none"> <li>• <b>Nonuniform brightness</b></li> <li>• Incorrect or missing colors</li> <li>• Light leakage around the display</li> <li>• Image persistence or image sticking on screen</li> </ul> Is the primary issue nonuniform brightness?	No	Go to step 42.	`\${nodeText.noSymptomCode}`	
38.	Determine whether variation in uniformity appears excessive when compared to a known-good similar computer.	Yes	Go to step 39.	`\${nodeText.yesSymptomCode}`	
	Does nonuniform brightness exceed that of a known-good computer?	No	Display panel seems to be within specifications. Do not replace display panel. Verify resolution.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
39.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove display panel. Inspect for mechanical interference from screws or cables making contact with back of display panel. Reseat components and cables.</p> <p>Carefully clean all surfaces of any leftover tape or adhesive residue where panel contacts enclosure edges to ensure a good seal and a flat mating surface when display is resealed to these surfaces.</p> <p>Is normal video restored?</p>	Yes	Issue resolved by reseating internal components. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 40.	`\${nodeText.noSymptomCode}`	
40.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Inspect and reseat backlight cable.</p> <p>Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.</p> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul> <p>Is normal video restored?</p>	Yes	Issue resolved by reseating backlight cables. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 41.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
41.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Reseat eDP cable connector securely to logic board. Reconnect all internal cables and reinstall display panel. Retest.</p> <p>Is normal video restored?</p>	Yes	Issue resolved by reseating embedded DisplayPort (eDP) cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L21	LCD
42.	<p>Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the three issues below, determine if "incorrect or missing colors" best describes the primary symptom:</p> <ul style="list-style-type: none"> <li>• <b>Incorrect or missing colors</b></li> <li>• Light leakage around the display</li> <li>• Image persistence or image sticking on screen</li> </ul> <p>Is the primary issue incorrect or missing colors?</p>	Yes	Go to step 43.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 51.	`\${nodeText.noSymptomCode}`	
43.	<p>Verify that display is listed in System Information &gt; Hardware &gt; Graphics/Displays &gt; Video Card. This ensures that color profile can be matched with display panel.</p> <p>Is display hardware detected?</p>	Yes	Go to step 44.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 45.	`\${nodeText.noSymptomCode}`	
44.	<p>Go to System Preferences &gt; Displays &gt; Color to verify "iMac" is selected under Display profile. Inspect display again for incorrect or missing colors.</p> <p>Are colors still incorrect or missing when display profile is set to "iMac"?</p>	Yes	Go to step 45.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved by setting a valid display profile. User may have created an off-color calibration setting. Verify resolution.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
45.	Run Mac Resource Inspector (MRI) suite from AST or AST 2 to check if the display is fully recognized by the computer.	Yes	Go to step 47.	`\${nodeText.yesSymptomCode}`	
	If MRI is not available, go to System Information > Graphics/Displays to verify that Color LCD is recognized.	No	Go to step 46.	`\${nodeText.noSymptomCode}`	
	Is display hardware detected in MRI?				
46.	<b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.	Yes	Issue resolved by reseating embedded DisplayPort (eDP) cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
	Reseat eDP cable connector securely to logic board. Reconnect all internal cables and reinstall display panel. Retest.				
	Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.	No	Go to step 47.	`\${nodeText.noSymptomCode}`	
	<b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in.				
	Is normal video restored?				
47.	Launch the Test Pattern Tool (TPT) in AST or the Display Anomalies test suite in AST 2 to display the Solid Gray Light display test pattern.	Yes	Go to step 49.	`\${nodeText.yesSymptomCode}`	
	Verify whether incorrect/missing color issue affects entire screen.	No	Go to step 48.	`\${nodeText.noSymptomCode}`	
	Is entire screen affected?				
48.	Put computer side-by-side with a known-good equivalent iMac display showing same Solid Gray Light image.	Yes	Go to step 49.	`\${nodeText.yesSymptomCode}`	
	Is issue noticeably worse on the user's display?	No	Small variations in color uniformity are normal and do not warrant replacement of display.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
49.	<p>Troubleshooting this issue completely requires a known-good display panel.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 50.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L02	LCD
50.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel to test logic board video output.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L02	LCD
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M04	MLB

	Check	Result	Action	Code	Commodity
51.	<p>Use the Display Anomalies test suite in AST or AST 2 or compare an image on the user's display with the same image on an equivalent, known-good display.</p> <p>Of the two issues below, determine if "light leakage around the display" best describes the primary symptom:</p> <ul style="list-style-type: none"> <li>• <b>Light leakage around the display</b></li> <li>• Image persistence or image sticking on screen</li> </ul> <p>Is the primary issue light leakage around the display?</p>	Yes	Go to step 52.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 55.	`\${nodeText.noSymptomCode}`	
52.	<p>Launch the Test Pattern Tool (TPT) in AST or the Display Anomalies test suite in AST 2 to display the All Black display test pattern.</p> <p>It is very important that you verify this issue using ONLY an all black display test pattern with no other images present such as icons, dock, and so on.</p> <p>Adjust display position and brightness to normal settings.</p> <p>Dim lights so you can more clearly see any light leakage around edges of the display panel.</p> <p>Is any noticeable light leakage present around edges of the display?</p>	Yes	Go to step 53.	`\${nodeText.yesSymptomCode}`	
		No	Explain to user that display is within specifications. Do not replace display panel. Verify resolution.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
53.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p>	Yes	<p>Replace the chin strap. Reinstall user's display panel.</p> <p>Verify that the issue is resolved.</p>	X13	PIECE PART
	<p>Carefully disconnect and remove display panel.</p> <p>Carefully clean all surfaces of any leftover tape or adhesive residue where panel contacts enclosure edges to ensure a good seal and a flat mating surface when display is reseated to these surfaces.</p> <p>Remove and closely inspect chin strap for any damage, bowing, or bending.</p> <p>Verify that all cushioned pads are securely installed on each end of the chin strap and are not damaged, torn, out of place, or missing. These pads are part of the chin strap.</p> <p>Does chin strap appear damaged, bent, or bowed?</p>	No	Go to step 54.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	

	Check	Result	Action	Code	Commodity
54.	<p>Recheck that previous disassembly was performed properly using proper tools and techniques and not by simply pulling display off. Incorrect removal technique can damage or bow chin strap, causing light leakage in lower display area.</p> <p>Reinstall chin strap, being very careful to not damage, bow, or otherwise bend chin strap during installation.</p> <p>Reapply new foam tape gaskets for all four display sides, being very careful to apply the tape smoothly around entire edge.</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L28	LCD
	<p>Reinstall display panel, being careful when seating edges of display against foam-backed tape around edges to ensure a smooth, complete seal around entire perimeter.</p> <p>Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.</p> <p>Retest using the Test Pattern Tool (TPT) in AST or the Display Anomalies test suite in AST 2 to display the All Black display test pattern.</p> <p>Is any noticeable light leakage still present around edges of display?</p>	No	<p>Issue resolved by reseating display and chin strap. Verify issue resolution.</p>	<p>Issue resolved by reseating display and chin strap. Verify issue resolution.</p> <p>Issue resolved by reseating display and chin strap. Verify issue resolution.</p>	
55.	<p>A display might show a temporary faint remnant of a previous image even after a new image replaces it. Follow instructions using procedure listed for this computer in <a href="#">TP949: Image Persistence Test</a> to determine if display fails or passes the Image Persistence Test.</p> <p>Does the display fail the Image Persistence Test?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L25	LCD
		No	<p>The display is within specification. Do not replace display panel.</p>	<p>The display is within specification. Do not replace display panel.</p> <p>The display is within specification. Do not replace display panel.</p>	

	Check	Result	Action	Code	Commodity
56.	Verify that display issue or anomaly has been resolved.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	<p>Run AST or AST 2 Full System Diagnostic (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	M99	

# Power But No Video

## Unlikely causes:

Battery, camera/microphone/ALS cable, CPU fan, flash storage card, left speaker, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antennas.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Power available, but no video visible on display.</li><li>• Fan spinning sounds are audible.</li><li>• Caps Lock key LED illuminates when pressed.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p><b>Note:</b> Verify that the computer startup process passes initial memory checks and POST (Power-On Self-Test) with some video activity. Some iMac models may not produce video in response to faulty or incompatible memory, which can lead to symptoms such as the ones covered in this procedure. Replace the user's memory with known-good, compatible Apple memory and verify the issue again before continuing with troubleshooting.</p> <ol style="list-style-type: none"><li>1. Adjust settings to increase screen brightness.</li><li>2. After logic board replacement, if the computer does not turn on or diagnostic LEDs do not function, this could mean that the replacement logic board has not yet been configured for use. For complete instructions to configure a replacement logic board, refer to <a href="#">TP1657: System Configuration for Mac Computers with the Apple T2 Security Chip</a>. Always complete all applicable procedures and diagnostic suites after part replacement, to ensure that the new part operates properly with the rest of the system.</li><li>3. Check if the computer is in recovery mode. This may happen if a software installation is interrupted. Connect the computer to a host Mac. On the host Mac go to Apple &gt; About this Mac &gt; System Report &gt; USB. If the computer is connected and in recovery mode you should see a message such as "Apple Mobile Device (Recovery)". If the computer is in recovery mode, then the computer's T2 firmware will need to be restored using Apple Configurator. Follow steps in <a href="#">Revive or restore Mac firmware in Apple Configurator 2</a> to revive the T2 firmware on the user's computer before performing further troubleshooting. Restart the computer and verify that it completely starts up to macOS. Refer to <a href="#">HT208862: About the Apple T2 Security Chip</a> for more information.</li><li>4. Try to determine what the computer was doing during startup. Refer to <a href="#">HT204156: If your Mac doesn't start up all the way</a>.</li><li>5. Determine whether the computer has power by confirming that any of the following function correctly:<ul style="list-style-type: none"><li>• Fan spinning sound</li><li>• Display backlight on</li><li>• Any display activity</li><li>• Caps Lock key light turns on when pressed on wired keyboard</li></ul></li></ol> <p>If the computer shows no signs of power, then return to the list of symptoms and select "No Power" from the troubleshooting menu.</p> <ol style="list-style-type: none"><li>6. Verify that the computer completes the full startup process: Apple logo &gt; progress indicator &gt; login screen &gt; user's desktop. If the computer shows signs of power but does not start up fully, then return to the list of symptoms and select "Will Not Start Up" from the troubleshooting menu.</li><li>7. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>8. Reset the SMC using the procedure listed for this</li></ol>

	<p>computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>.</p> <ol style="list-style-type: none"> <li>9. Disconnect all peripherals.</li> <li>10. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See <a href="#">HT201314: About macOS Recovery</a>.</li> <li>11. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to verify system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP833: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>
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## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine whether issue is no backlight or no image: <ul style="list-style-type: none"> <li>• Image with no backlight can be seen by shining a flashlight onto the built-in display during or after startup.</li> <li>• No image can be identified by a blank display with or without backlight or a solid color on the built-in display.</li> </ul>	No Backlight	If the display shows an image with no backlight, then return to the list of symptoms and select “Backlight Issues or No Backlight” from the troubleshooting menu.	<code>\${nodeText.yesSymptomCode}</code>	
	Is the issue no backlight or no image?	No Image	Go to step 2.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
2.	<p>Run AST or AST 2 Mac Resource Inspector diagnostic suite (MRI). Review MRI results or System Information &gt; Graphics/Displays. Look for information indicating internal display presence in results.</p> <p>Does MRI detect the display?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L03	LCD
3.	<p>Follow Service Guide procedures to remove the display panel.</p> <p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Remove the display panel.</p> <p>Inspect eDP cable for misrouting. Disconnect eDP cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is the cable or its connector damaged?</p>	Yes	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	<p>Keep eDP cable disconnected from logic board. Inspect eDP connector on the logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 5.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
5.	Reseat the eDP cable between display panel and logic board.  <b>Warning:</b> Be extremely careful when working inside the computer when power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.	Yes	Issue resolved by reseating embedded DisplayPort (eDP) cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	
6.	Is normal video restored?  Troubleshooting this issue completely requires a known-good eDP cable.  The iMac Display Extension Cable Kit contains an eDP substitution cable that can be used for testing.  Refer to <a href="#">TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit</a> for information about how to use extension cables.  Do you have immediate access to a known-good eDP cable?	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
		No	Replace the embedded DisplayPort (eDP) cable.  Verify that the issue is resolved.	X03	INTERNAL CABLE
7.	<b>Important:</b> Ensure that user's computer is shut down, then remove the power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.  Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.  Is normal video restored?	Yes	Replace the embedded DisplayPort (eDP) cable.  Verify that the issue is resolved.	X03	INTERNAL CABLE
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	Troubleshooting this issue completely requires a known-good display panel.  Do you have immediate access to a known-good display panel?	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	Replace the display panel.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	L03	LCD

	Check	Result	Action	Code	Commodity
9.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L03	LCD
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M03	MLB
10.	<p>Restart the computer and verify that the video is fully functional.</p> <p>Run AST 2 Full System Diagnostic (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Unstable Flickering

## Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, hard disk drive (HDD) (some models), hard drive data or power or combo cable (some models), left speaker, memory, power supply, rear enclosure, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Flickering video image.</li><li>• Flickering backlight.</li><li>• Dock or menu bar position not stable.</li><li>• Display intermittently flashes on and off.</li><li>• Unstable image.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"><li>1. Use macOS Recovery to troubleshoot potential software issues. Hold down Command-R during startup to restart from the recovery partition. See <a href="#">HT201314: About macOS Recovery</a>.</li><li>2. Check the brightness setting.</li><li>3. Refer to HT201260: Find out which macOS your Mac is using to verify the system build is correct for this computer model. Check for and apply the latest software and firmware updates, especially those that deal with display or graphic issues. Remember that some external Apple display adapters also contain firmware that may need updating. For more information, refer to <a href="#">HT201177: Get help with video issues on external displays connected to your Mac</a>.</li><li>4. Clean display and check for dust or debris.</li><li>5. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>6. Reset the SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li><li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Adjust built-in display brightness setting to low backlight level, just above off.	Backlight	Go to step 2.	\${nodeText.yesSymptomCode}	
	<p>Verify whether user issue is due to backlight flickering or to an unstable or flickering video image on display.</p> <p>You may need to shine a bright (low heat) flashlight onto front of display panel with computer turned ON to verify whether a faint video image is occasionally visible through the flickering.</p> <p><b>Note:</b> If video is present but backlight never turns on, exit this procedure and go to the “Backlight Issues or No Backlight” troubleshooting flow instead. Use this procedure only for flickering backlight or video image.</p> <p><b>Note:</b> Follow Service Guide procedures to remove the display panel before the next step.</p> <p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Remove the display panel.</p> <p>Which is flickering, backlight or video?</p>	Video	Go to step 8.	\${nodeText.noSymptomCode}	
2.	Inspect display power cable and its connectors between logic board and display panel.	Yes	<p>Replace the display panel, which includes the display power cable.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L06	LCD
	Is display power cable damaged?		Go to step 3.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
3.	Reseat display power cable between logic board and display panel. Connect power cord to computer, wait five seconds for SMC to become ready, then press power button to start up computer.	Yes	Issue resolved by reseating display power cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
	<p>Warning: Be extremely careful when working inside the computer while power is connected and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul> <p>Is normal video restored?</p>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	<p>To troubleshoot this issue completely, a known-good display panel is required.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L06	LCD

	Check	Result	Action	Code	Commodity
5.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L06	LCD
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	<p>To troubleshoot this issue completely, a known-good power supply is required.</p> <p>Do you have immediate access to a known-good power supply?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P99	POWER SUPPLY
7.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good power supply.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P99	POWER SUPPLY
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	M99	
8.	<p>Inspect eDP cable for misrouting. Disconnect eDP cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is the cable or its connector damaged?</p>	Yes	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 9.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
9.	<p>Keep eDP cable disconnected from logic board. Inspect eDP connector on the logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 10.	\${nodeText.noSymptomCode}	
10.	<p>Reseat the eDP cable between display panel and logic board.</p> <p><b>Warning:</b> Be extremely careful when working inside the computer when power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>Is normal video restored?</p>	Yes	Issue resolved by reseating embedded DisplayPort (eDP) cable. Verify issue resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 11.	\${nodeText.noSymptomCode}	
11.	<p>Troubleshooting this issue completely requires a known-good eDP cable.</p> <p>The iMac Display Extension Cable Kit contains an eDP substitution cable that can be used for testing.</p> <p>Refer to <a href="#">TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit</a> or <a href="#">TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit</a> for information about how to use extension cables.</p> <p>Do you have immediate access to a known-good eDP cable?</p>	Yes	Go to step 12.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE

	Check	Result	Action	Code	Commodity
12.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove the power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 13.	\${nodeText.noSymptomCode}	
13.	<p>To troubleshoot this issue completely, a known-good display panel is required.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L06	LCD

	Check	Result	Action	Code	Commodity
14.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L06	LCD
		No	<p>Reinstall user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M29	MLB
15.	<p>Confirm that the computer display flickering or unstable video issue is resolved.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

# Audio Input Issues

## Unlikely causes:

Battery, camera (some models), camera/microphone/ALS cable or camera cable, fan, eDP cable, hard disk drive (HDD) (some models), hard drive data or power or combo cable (some models), display panel, left speaker, memory, power supply, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Audio input port does not function, but audio output is functional.</li><li>Audio input port produces distorted audio.</li><li>Audio input port cannot be selected.</li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>Some iMac models do not support optical audio. Refer to Apple product specifications for more information.</li><li>Verify that nothing is inserted into the audio input port on the user's computer. Use an otoscope to visually inspect the port.</li><li>Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.</li><li>Go to System Preferences &gt; Sound, and verify the following:  Input tab:<ul style="list-style-type: none"><li>External Microphone is available and selected for sound input.</li><li>"Input volume" is not set to zero.</li></ul> Output tab:<ul style="list-style-type: none"><li>Internal Speaker is available and selected for sound output.</li><li>"Output volume" is not muted or set to zero.</li></ul></li><li>Go to System Preferences &gt; Sound &gt; Input tab, and verify that the "Input level" indicator moves when speaking into the EarPod's microphone.</li><li>Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model:	A	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<ul style="list-style-type: none"><li>A. iMac Pro (2017), or other iMacs with the T2 Security Chip</li><li>B. iMacs without the T2 Security Chip</li></ul> <p>Refer to <a href="#">HT208862: About the Apple T2 Security Chip</a> for more information.</p> <p>Which iMac model?</p>	B	Go to step 3.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
2.	Follow steps in <a href="#">Revive or restore Mac firmware in Apple Configurator 2</a> to restore the T2 firmware on the user's computer.	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	<p>Restart the computer and verify that it completely starts up to macOS.</p> <p>Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.</p> <p>Retest by going to System Preferences &gt; Sound &gt; Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Does the issue persist after restoring T2 firmware?</p>	No	The issue was resolved by restoring T2 firmware.	`\${nodeText.noSymptomCode}`	
3.	Start up the computer to a known-good external macOS startup volume.	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	<p>Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.</p> <p>Retest by going to System Preferences &gt; Sound &gt; Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Does the issue persist with a known-good macOS?</p>	No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	
4.	Disconnect any connected headphones or external speakers. Check whether System Preferences > Sound > Input tab shows an "Internal microphone" source available and selected.	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	Does System Preferences list "External microphone" instead?	No	Go to step 6.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	Debris in, or damage to, the headphone jack can cause the computer to become stuck in External Microphone input mode.	Yes	<b>ESCALATION REQUIRED.</b>  The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify that the issue is resolved.	X13	
	Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.  Use compressed air to clean and remove any debris.  Is there any damage to the headphone jack?		Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> .  Contact CSS for additional support regarding warranty coverage for this part.		
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	
6.	Run AST or AST 2 Audio Test suite to verify that built-in microphones detect expected audio test patterns produced from each speaker.	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
	Refer to <a href="#">TP587: Using Audio Test</a> .  Does the computer pass Audio test suite?	No	If the microphone tests failed, then return to the list of symptoms and select "Internal Microphone Issues" from the troubleshooting menu.	`\${nodeText.noSymptomCode}`	
7.	Connect known-good Apple EarPods with 3.5 mm Headphone Plug to the audio input port (headphone jack) on the user's computer. Verify that the 3.5 mm stereo plug is seated fully in the port.	Yes	Issue resolved.  Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Retest by going to System Preferences > Sound > Input tab, and verifying that the input level indicator moves when speaking into the microphone.  Is the issue resolved?	No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M09	MLB



	Check	Result	Action	Code	Commodity
8.	Verify that external audio input is available, selected, and functional, and that the "Input level" indicator moves when speaking into a connected microphone. Then record a sample audio file and play it back to verify that it is free of distortion.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>Run AST or AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	

# Camera Issues

## Unlikely causes:

Battery, fan, eDP cable, left speaker, memory, power supply, rear enclosure, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antennas.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Camera not detected.</li><li>• No green LED for camera.</li><li>• Excessive blooming.</li><li>• Poor white balance.</li><li>• Poor focus.</li><li>• Green image.</li><li>• Image distortion.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to verify system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li><li>2. Verify that the camera lens and display are clean and clear of contaminants.</li><li>3. Verify that another application is not using the camera. Refer to <a href="#">HT201715: “Your camera is in use by another application” message</a>.</li><li>4. Ask user about lighting conditions in his or her working environment. Dim lighting causes poor image quality. Overly bright lighting can bounce off surfaces onto subject and make image foggy.</li><li>5. Striped, textured, and mesh clothing can create moiré patterns in image.</li><li>6. Reset SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a> to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when resetting the SMC. You could inadvertently put the computer into DFU mode if you do.</li><li>7. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>8. Disconnect all peripheral devices and restart computer.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Check Mac Resource Inspector (MRI) diagnostic suite results to verify that the camera is detected.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>If AST 2 is not available, use System Information to verify that the FaceTime HD Camera is recognized.</p> <p>The camera will be listed in System Information &gt; Hardware &gt; Camera Device Tree. Verify that “FaceTime HD Camera (Internal)” is listed.</p> <p>Does MRI or System Information detect the camera?</p>	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	Launch Photo Booth. Verify that the green LED next to the camera illuminates when an image is present in Photo Booth.	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
	<p>Does the camera LED light up?</p>	No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Follow steps in <a href="#">Revive or restore Mac firmware in Apple Configurator 2</a> to revive the T2 firmware on the user’s computer.	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
	<p>Restart the computer and verify that it completely starts up to macOS.</p> <p>Retest the camera.</p> <p>Does the issue persist after restoring T2 firmware?</p>	No	The issue was resolved by restoring T2 firmware.	`\${nodeText.noSymptomCode}`	
4.	Verify that the camera image is clear and undistorted.	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Is the image clear?	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
5.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	<p>Remove display panel.</p> <p>Locate and disconnect the camera cable from the logic board and camera.</p> <p>Inspect both ends of the cable, the logic board connector, and the camera connector for any damage.</p> <p>Is there any damage to the camera cable or any connectors?</p>	No	Go to step 7.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
6.	<p>Determine whether the damage is located on the camera cable, the logic board, the camera, or a combination of multiple components.</p> <p>Is the damage limited to the camera cable only?</p>	Yes	<p>Replace the camera cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	
7.	<p>Reseat the camera cable securely to logic board and camera.</p> <p>Reassemble computer and check System Information again.</p> <p><b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b></p> <p>Does camera appear in System Information?</p>	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
		No	Go to step 9.	\${nodeText.noSymptomCode}	
8.	<p>Launch Photo Booth. Verify that the green LED next to camera lights up. Verify that the image appears normal.</p> <p>Does camera LED light up and image appear normal?</p>	Yes	<p>Issue resolved by reseating the camera cable.</p> <p>Verify resolution.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 11.	\${nodeText.noSymptomCode}	
9.	<p>Troubleshooting this issue completely requires a known-good camera cable.</p> <p>Do you have immediate access to a known-good camera cable?</p>	Yes	Go to step 10.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the camera cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
10.	<p>Substitute a known-good camera cable and retest.</p> <p>Is camera working normally?</p>	Yes	<p>Replace the camera cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 11.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
11.	<p>The camera is part of the display panel in this model.</p> <p>Troubleshooting this issue completely requires a known-good display panel.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the display panel, which includes the camera.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L17	LCD
12.	<p>Substitute a known-good display panel and retest.</p> <p>Is camera working normally?</p>	Yes	<p>Replace the display panel, which includes the camera.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L17	LCD
		No	<p>Reinstall the user's display panel.</p> <p>Replace logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M13	MLB

	Check	Result	Action	Code	Commodity
13.	<p>Verify that camera now functions as expected and that image quality is normal.</p> <p>Run AST 2 Full System Diagnostic (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	M99	



# Distorted Audio from Internal Speakers

## Unlikely causes:

Battery, camera (some models), camera/microphone/ALS cable or camera cable, fan, eDP cable, flash storage card/solid-state drive (SSD), hard disk drive (HDD) (some models), hard drive data or power or combo cable (some models), display panel, memory, power supply, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Sound is distorted, fuzzy, or crackly.</li><li>• Symptom only occurs with internal speakers.</li><li>• Symptom only occurs with external speakers or headphones.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Use controls to increase the sound volume to medium, halfway between minimum and maximum setting.</li><li>2. In System Preferences &gt; Sound &gt; Output, verify “Internal Speaker” output is available and selected.</li><li>3. Connect headphones or external speakers to the headphone jack. In System Preferences &gt; Sound &gt; Output, verify whether the Internal Speakers setting switches to Headphones, and whether audio can be played on headphones or external speakers.</li><li>4. Disconnect any device connected to the headphone jack. In System Preferences &gt; Sound &gt; Output, check that the sound output device reverts to Internal Speakers and that the Balance slider is set halfway between left and right.</li><li>5. If testing using iTunes, check that the equalizer is not turned on.</li><li>6. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>7. Test the audio output using more than one application or website.</li><li>8. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model.</li><li>9. Check for and apply the latest software and firmware updates.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li><li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model:  A. iMac Pro (2017), or other iMacs with the T2 Security Chip B. iMacs without the T2 Security Chip  Refer to <a href="#">HT208862: About the Apple T2 Security Chip</a> for more information.  Which iMac model?	A	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		B	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	Follow steps in <a href="#">Revive or restore firmware in Apple Configurator 2</a> to revive the T2 firmware on the user's computer.  Restart the computer and verify that it completely starts up to macOS.  Retest for speaker or headphone jack audio issue.  Does the issue persist after restoring T2 firmware?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	The issue was resolved by restoring T2 firmware.	`\${nodeText.noSymptomCode}`	
3.	Start up the computer to a known-good external macOS startup volume.  Retest for speaker or headphone jack audio issue.  Does the issue persist with a known-good macOS?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Reinstall macOS on the user's computer.  Check for and apply the latest software and firmware updates.  Verify that the issue is resolved.	`\${nodeText.noSymptomCode}`	
4.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Output tab and verify that Internal Speaker is available and selected for sound output.  Does System Preferences list "Headphones" instead?	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	<p>Debris in, or damage to, the headphone jack can cause the computer to become stuck in Headphone or External Speaker mode.</p> <p>Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.</p> <p>Use compressed air to clean and remove any debris.</p> <p>Is there any damage to the headphone jack?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify issue resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>Contact CSS for additional support regarding warranty coverage for this part.</p>	X09	
		No	Go to step 6	\${nodeText.noSymptomCode}	
6.	<p>Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to <a href="#">TP587: Using Audio Test</a>.</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 7.	\${nodeText.noSymptomCode}	
7.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Locate speaker connections on logic board. Disconnect and inspect both speaker cable connectors and corresponding connectors on logic board for damage.</p> <p>Reconnect the left and right speakers to the logic board, verifying that the connections are all seated properly.</p> <p>Did you find damage to speakers or logic board connector?</p>	Yes	Go to step 8.	\${nodeText.yesSymptomCode}	
		No	Go to step 9.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	Determine whether damage is on the logic board, speakers, or both.	Yes	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.  Verify that the issue is resolved.	X09	OTHER ELECTRIC
	Is the damage limited to speakers?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	
9.	With speaker connectors reseated to logic board, verify you can hear audio through internal speakers.	Yes	The issue was resolved by reseating cables. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>In System Preferences &gt; Sound &gt; Output tab, adjust Balance slider to check left and right speaker channel separation.</p> <p>Play music with high and low tones to check bass and tweeter performance of left and right speakers.</p> <p><b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b></p> <p>Do internal speakers present full range of expected audio performance?</p>	No	Go to step 10.	\${nodeText.noSymptomCode}	
10.	Inspect and carefully clean affected speaker cone using a soft tissue to remove dust, debris, or foreign material such as metal fragments that easily adhere to the magnetic speaker. Reseat speaker connection and retest.	Yes	Issue resolved by cleaning the speaker membrane. Verify resolution.	\${nodeText.yesSymptomCode}	
	Is sound from affected speaker audible, clear, and free of distortion?	No	Go to step 11.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
11.	<p>Troubleshooting this issue completely requires a known-good left and right speaker set.</p> <p>Internal speakers are specified to work as a matched pair and must be tested or replaced as matched pairs.</p> <p>Keep and identify your known-good speakers from one kit as a matched pair.</p> <p>Do you have immediate access to a known-good speaker set?</p>	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Verify that the issue is resolved.</p>	X09	OTHER ELECTRIC
12.	<p>Substitute a known-good internal speaker set and verify you can hear audio through internal speakers.</p> <p>Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to <a href="#">TP587: Using Audio Test</a>.</p> <p><b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b></p> <p>Does unit pass Audio Test?</p>	Yes	<p>Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.</p> <p>Verify that the issue is resolved.</p>	X09	OTHER ELECTRIC
		No	<p>Reinstall the user's speakers.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M09	MLB
13.	<p>Connect and disconnect headphones/external speakers. Verify that audio can be played through both external and internal speakers, and that sound is clear and free of distortion.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	

# External Apple Bluetooth Peripherals

## Unlikely causes:

There are no unlikely causes for this issue.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> <li>Apple Bluetooth wireless keyboard, mouse, or trackpad is not recognized by known-good computer</li> <li>Apple Bluetooth wireless keyboard, mouse, or trackpad will not pair with known-good computer</li> <li>Apple Bluetooth wireless keyboard, mouse, or trackpad intermittently loses its connection</li> <li>Apple Wireless Keyboard has one or more of the following issues: <ul style="list-style-type: none"> <li>No power</li> <li>Battery will not charge (for peripherals with embedded batteries)</li> <li>Expanded battery (for peripherals with embedded batteries)</li> <li>Battery runtime too short</li> <li>Will not turn off</li> <li>One or more keys do not work</li> <li>Keys seem to stick, do not respond properly, or respond slowly</li> <li>Wrong keyboard language</li> <li>Keys missing or falling off</li> <li>Paint wearing off of one or more keys</li> <li>Physical and/or cosmetic issues</li> </ul> </li> <li>Apple wireless mouse has one or more of the following issues: <ul style="list-style-type: none"> <li>No power</li> <li>Battery will not charge (for peripherals with embedded batteries)</li> <li>Expanded battery (for peripherals with embedded batteries)</li> <li>Battery runtime too short</li> <li>Will not turn off</li> <li>No mouse response</li> <li>Mouse click not recognized</li> <li>Mouse causes erratic cursor tracking</li> <li>Physical and/or cosmetic issues</li> </ul> </li> <li>Apple wireless trackpad has one or more of the following issues: <ul style="list-style-type: none"> <li>No power</li> <li>Battery will not charge (for peripherals with embedded batteries)</li> <li>Expanded battery (for peripherals with embedded batteries)</li> <li>Battery runtime too short</li> <li>Will not turn off</li> <li>No trackpad response</li> <li>Trackpad click not recognized</li> <li>Trackpad causes erratic cursor tracking</li> <li>Trackpad requires high click force</li> <li>Trackpad click overly sensitive</li> <li>Force Touch or haptic feedback issue</li> <li>Physical and/or cosmetic issues</li> </ul> </li> </ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p><b>Important:</b> This troubleshooting procedure is intended <u>only</u> for Apple Bluetooth wireless peripheral devices, such as the following Apple products:</p> <ul style="list-style-type: none"> <li>Magic Mouse or Magic Mouse 2</li> <li>Magic Trackpad or Magic Trackpad 2</li> <li>Apple Wireless Keyboard or Magic Keyboard</li> </ul> <p>For simplicity, this procedure refers to these products as wireless mouse, wireless trackpad, and wireless keyboard unless otherwise noted.</p> <p>For third-party devices, contact the manufacturer for support, software/firmware updates, or service options.</p> <ol style="list-style-type: none"> <li>Verify compatibility of the user's Apple wireless mouse, keyboard, or trackpad. Refer to <a href="#">HT201806: How to identify your Apple wireless mouse, keyboard, or trackpad</a>.</li> <li>Check for and apply the latest software and firmware updates.</li> <li>In System Preferences, make sure Bluetooth is on and set to Discoverable.</li> <li>For Apple Bluetooth peripherals with replaceable batteries, such as Magic Mouse, Magic Trackpad, or Apple Wireless Keyboard: If the device does not turn on, then install new or fully charged batteries.</li> <li>For Apple Bluetooth peripherals with embedded batteries, such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard: If the device does not turn on, then connect a known-good USB Power Adapter and Lightning cable to the device to charge it for at least two minutes. Switching the device on/off button or switch to the on position will allow the device to charge more quickly than when off.</li> <li>For Apple Bluetooth peripherals with embedded batteries such as Magic Mouse 2, Magic Trackpad 2, or Magic Keyboard, verify that the computer being used with the peripheral supports Bluetooth 4.0 or later. Computers with earlier versions of Bluetooth support will not pair with Apple Bluetooth peripherals with embedded batteries.</li> <li>Reset Bluetooth device or delete pairing (if applicable).</li> <li>If Bluetooth pairs normally at your service location, then research potential sources of interference in the user's environment, such as microwave ovens or cordless phones in the 2.4/5GHz range. Refer to <a href="#">HT201542: Resolve Wi-Fi and Bluetooth issues caused by wireless interference</a>.</li> <li>Magic Mouse 2, Magic Trackpad 2, and Magic Keyboard can pair with the computer using either Bluetooth or a Lightning cable. If Bluetooth pairing is not possible due to interference or other reasons, then try pairing these products by connecting them to the known-good computer with a known-good Lightning cable. Refer to <a href="#">HT201178: Set up your Apple wireless mouse, keyboard, and trackpad</a>.</li> <li>For keyboard issues, refer to <a href="#">HT204540: If your Apple keyboard doesn't work</a> and <a href="#">HT203162: One or more keys on the keyboard do not respond</a> for troubleshooting tips.</li> </ol>

## Deep Dive



	Check	Result	Action	Code	Commodity
1.	Visually inspect the user's wireless mouse, wireless trackpad, or wireless keyboard for any physical, cosmetic, and liquid damage.	Yes	Go to step 2.	\${nodeText.yesSymptomCode}	
	On a wireless mouse or wireless trackpad, verify that the mouse or trackpad button clicks.	No	Go to step 11.	\${nodeText.noSymptomCode}	
	On keyboards, verify that all keyboard buttons are present and can be depressed normally.				
	Does the user's wireless mouse, wireless trackpad, or wireless keyboard show signs of damage?				
2.	Determine whether there is a safety issue, such as fumes, excessive heat, or shock.	Yes	Go to step 3.	\${nodeText.yesSymptomCode}	
	Do not perform procedures that can be a safety risk to you or the user.	No	<b>ESCALATION REQUIRED.</b> Contact CSS for additional support regarding safety procedures for this product.	\${nodeText.noSymptomCode}	
	Can you proceed safely?				
3.	Isolate damage issue to either user's wireless keyboard or wireless mouse or trackpad.	Wireless keyboard	Go to step 4.	\${nodeText.yesSymptomCode}	
		Wireless mouse or trackpad	Go to step 8.	\${nodeText.noSymptomCode}	
	Which peripheral is damaged?				
4.	Closely examine the user's device to determine exact nature of the issue.	Yes	Replace the user's wireless keyboard out of warranty.	K90	KEYBOARD
	Look for any signs of liquid spill, liquid penetration, or liquid damage to device.	No	Go to step 5.	\${nodeText.noSymptomCode}	
	Is damage to user's device related to liquid spill?				
5.	Closely examine the user's device for any signs of physical damage that may affect operation.	Yes	Replace the user's wireless keyboard out of warranty.	K16	KEYBOARD
	Does the user's device exhibit this symptom?	No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	Closely examine the user's device for signs of paint wearing off of one or more keys.	Yes	Replace the user's wireless keyboard out of warranty.	K35	KEYBOARD
	Does the user's device exhibit this symptom?	No	Go to step 7.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless keyboard out of warranty.	K21	KEYBOARD
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
8.	Closely examine the user's device to determine exact nature of the issue.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K90	MOUSE
	Look for any signs of liquid spill, liquid penetration, or liquid damage to device.	No	Go to step 9.	\$(nodeText.noSymptomCode)	
	Is damage to user's device related to liquid spill?				
9.	Closely examine the user's device for any signs of physical damage that may affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K16	MOUSE
	Does the user's device exhibit this symptom?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
10.	Closely examine the user's device for any signs of cosmetic damage that does not affect operation.	Yes	Replace the user's wireless mouse or wireless trackpad out of warranty.	K21	MOUSE
	Does the user's device exhibit this symptom?	No	Issue cannot be duplicated.	\$(nodeText.noSymptomCode)	
11.	Follow steps listed in <a href="#">HT201171: Using a Bluetooth mouse, keyboard, or trackpad with your Mac</a> to pair the user's Bluetooth device with a known-good Mac.	Yes	<b>ESCALATION REQUIRED.</b>  The Bluetooth device appears to be performing to specifications. There may be an issue with the user's computer, or wireless interference in user's environment.  If issue persists, then contact CSS for additional support.	\$(nodeText.yesSymptomCode)	
	Test the user's wireless mouse, wireless trackpad, or wireless keyboard manually, using built-in applications on a known-good Mac. For example, use the Notes application to check the keys on a wireless keyboard.				
	Refer to <a href="#">HT204621: If your Apple wireless mouse, keyboard, or trackpad aren't working as expected</a> for tips to resolve issues.				
12.	Does the user's wireless mouse, wireless trackpad, or wireless keyboard pair and function normally?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
	Isolate failure to either user's wireless keyboard or wireless mouse or trackpad.	Wireless keyboard	Go to step 13.	\$(nodeText.yesSymptomCode)	
	Which peripheral is malfunctioning?	Wireless mouse or trackpad	Go to step 29.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
13.	Look for for any signs of power on the user's wireless keyboard, such as a power LED turning on. <b>Note:</b> Not all devices have a power LED.	Yes	Go to step 14.	\$(nodeText.yesSymptomCode)	
	Verify that the user's wireless keyboard turns ON when the on/off button or switch is placed in the on position.  Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position.  Does the user's wireless keyboard exhibit any power-related symptoms?	No	Go to step 18.	\$(nodeText.noSymptomCode)	
14.	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"><li>User's wireless keyboard is not functioning at all (seems dead, no power, power LED does not turn on)</li></ul>	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K09	KEYBOARD
	Does the user's wireless keyboard exhibit this symptom?	No	Go to step 15.	\$(nodeText.noSymptomCode)	
15.	Verify that the user's wireless keyboard turns on when the on/off button or switch is placed in the on position.	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K19	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"><li>On/off switch or button is defective</li></ul> Does the user's wireless keyboard exhibit this symptom?	No	Go to step 16.	\$(nodeText.noSymptomCode)	
16.	Verify that the user's wireless keyboard turns off when the on/off button or switch is placed in the off position.	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K34	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"><li>User's wireless keyboard remains on when the on/off button or switch has been placed in the off position</li></ul> Does the user's wireless keyboard exhibit this symptom?	No	Go to step 17.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
17.	Verify if the user's wireless keyboard has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K20	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>Power Issue, not due to on/off button or switch</li> </ul>	No	Go to step 18.	`\${nodeText.noSymptomCode}`	
	Does the user's wireless keyboard exhibit this symptom?				
18.	If the user's issue involves pairing or connecting to a Magic Keyboard, then you can connect to, pair, and use this device with the computer using either Bluetooth or a Lightning cable.	Yes	Go to step 19.	`\${nodeText.yesSymptomCode}`	
	If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Keyboard to the known-good computer with a known-good Lightning cable.	No	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K30	KEYBOARD
	For other Apple Bluetooth peripherals, select the "Yes" answer to continue.  Does the user's Magic Keyboard connect and pair using USB?				
19.	Verify that the known-good computer can recognize the user's wireless keyboard.	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K15	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>User's wireless keyboard is not recognized by known-good computer</li> </ul>	No	Go to step 20.	`\${nodeText.noSymptomCode}`	
	Does the user's wireless keyboard exhibit this symptom?				
20.	Verify that the known-good computer can pair with the user's wireless keyboard using Bluetooth.	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K07	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>User's wireless keyboard cannot pair with a known-good computer</li> </ul>	No	Go to step 21.	`\${nodeText.noSymptomCode}`	
	Does the user's wireless keyboard exhibit this symptom?				

	Check	Result	Action	Code	Commodity
21.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless keyboard, and does not drop this connection.	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K08	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>User's wireless keyboard intermittently loses its connection with a known-good computer</li> </ul> Does the user's wireless keyboard exhibit this symptom?	No	Go to step 22.	\${nodeText.noSymptomCode}	
22.	Ask the user how often and how long the wireless keyboard is used.	Yes	Go to step 23.	\${nodeText.yesSymptomCode}	
	Explain to the user that the battery issue could likely be caused by the user using the wireless keyboard continuously over a long period of time, rather than any fault of the wireless keyboard itself, macOS, or the user's computer.  Gain agreement from the user that lengthy wireless keyboard usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless keyboard itself.  Does the user agree that the battery life issue is likely caused by lengthy wireless keyboard usage?	No	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K32	KEYBOARD
23.	Attempt to charge the user's wireless keyboard battery for several more minutes. Verify that the user's wireless keyboard battery charge level that appears on the known-good computer that is paired with this user's wireless keyboard has increased and shows that the user's wireless keyboard is charging.	Yes	Replace the user's wireless keyboard.  Verify that the issue is resolved.	K31	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>User's wireless keyboard battery will not charge</li> </ul> <b>Note:</b> This symptom does not apply to peripherals with replaceable batteries.  Does the user's wireless keyboard exhibit this symptom?	No	Go to step 24.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
24.	Closely inspect the user's wireless keyboard enclosure for signs of an expanded battery.	Yes	Replace the user's wireless keyboard.	K33	KEYBOARD
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>User's wireless keyboard battery appears expanded</li> </ul> <p><b>Note:</b> This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless keyboard exhibit this symptom?</p>		Verify that the issue is resolved.		
25.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	No	Go to step 25.	\${nodeText.noSymptomCode}	
		Yes	Replace the user's wireless keyboard.		
26.	Verify that each and every wireless keyboard key functions as expected when pressed and released.	No	Go to step 26.	\${nodeText.noSymptomCode}	
		Yes	Replace the user's wireless keyboard.		
27.	Verify that each and every wireless keyboard key is intact and not missing.	No	Go to step 27.	\${nodeText.noSymptomCode}	
		Yes	Replace the user's wireless keyboard.		
28.	Verify that the wireless keyboard language is as expected.	No	Go to step 28.	\${nodeText.noSymptomCode}	
		Yes	Replace the user's wireless keyboard.		
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>Keys seem to stick, do not respond properly, or respond slowly</li> </ul> <p>Does the user's wireless keyboard exhibit this symptom?</p>	No	Go to step 26.	\${nodeText.noSymptomCode}	
		Yes	Replace the user's wireless keyboard.		
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>Keys missing or falling off</li> </ul> <p>Does the user's wireless keyboard exhibit this symptom?</p>	No	Go to step 27.	\${nodeText.noSymptomCode}	
		Yes	Replace the user's wireless keyboard.		
	Confirm that the issue with the user's wireless keyboard is: <ul style="list-style-type: none"> <li>Wrong keyboard language version</li> </ul> <p>Does the user's wireless keyboard exhibit this symptom?</p>	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
		Yes	Replace the user's wireless keyboard.		

	Check	Result	Action	Code	Commodity
29.	Look for for any signs of power on the user's wireless mouse or trackpad, such as a power LED turning on. <b>Note:</b> Not all devices have a power LED.	Yes	Go to step 30.	`\${nodeText.yesSymptomCode}`	
	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	No	Go to step 34.	`\${nodeText.noSymptomCode}`	
	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.				
	Does the user's wireless mouse or trackpad exhibit any power-related symptoms?				
30.	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"><li>User's wireless mouse or trackpad is not functioning at all (seems dead, no power, power LED does not turn on)</li></ul>	Yes	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K09	MOUSE
	Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 31.	`\${nodeText.noSymptomCode}`	
31.	Verify that the user's wireless mouse or trackpad turns on when the on/off button or switch is placed in the on position.	Yes	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K19	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"><li>on/off switch or button is defective</li></ul>	No	Go to step 32.	`\${nodeText.noSymptomCode}`	
	Does the user's wireless mouse or trackpad exhibit this symptom?				
32.	Verify that the user's wireless mouse or trackpad turns off when the on/off button or switch is placed in the off position.	Yes	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K34	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"><li>User's wireless mouse or trackpad remains on when the on/off button or switch has been placed in the off position</li></ul>	No	Go to step 33.	`\${nodeText.noSymptomCode}`	
	Does the user's wireless mouse or trackpad exhibit this symptom?				



	Check	Result	Action	Code	Commodity
33.	Verify if the user's wireless mouse or trackpad has any other power-related issue that is not related to the on/off button or switch.	Yes	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K20	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> <li>Power Issue, not due to on/off button or switch</li> </ul> Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 34.	\$(nodeText.noSymptomCode)	
34.	If the user's issue involves pairing or connecting to a Magic Mouse 2 or Magic Trackpad 2, then you can connect to and pair these devices with a computer using either Bluetooth or a Lightning cable.	Yes	Go to step 35.	\$(nodeText.yesSymptomCode)	
	If Bluetooth pairing is not possible due to interference or other reasons, then try connecting the user's Magic Mouse 2 or Magic Trackpad 2 to a known-good computer with a known-good Lightning cable.  For other Apple Bluetooth peripherals, select the "Yes" answer to continue.  Does the user's Magic Mouse 2 or Magic Trackpad 2 connect and pair using USB?	No	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K30	MOUSE
35.	Verify that the known-good computer can recognize the user's wireless mouse or trackpad.	Yes	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K15	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> <li>User's wireless mouse or trackpad is not recognized by known-good computer.</li> </ul> Does the user's wireless mouse or trackpad exhibit this symptom?	No	Go to step 36.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
36.	Verify that the known-good computer can pair with the user's wireless mouse or trackpad.	Yes	Replace the user's wireless mouse or trackpad.	K07	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> <li>User's wireless mouse or trackpad cannot pair with a known-good computer</li> </ul> Does the user's wireless mouse or trackpad exhibit this symptom?		Verify that the issue is resolved.		
		No	Go to step 37.	`\${nodeText.noSymptomCode}`	
37.	Verify that the known-good computer maintains a Bluetooth connection to the user's wireless mouse or trackpad, and does not drop this connection.	Yes	Replace the user's wireless mouse or trackpad.	K08	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> <li>User's wireless mouse or trackpad intermittently loses its connection with a known-good computer</li> </ul> Does the user's wireless mouse or trackpad exhibit this symptom?		Verify that the issue is resolved.		
		No	Go to step 38.	`\${nodeText.noSymptomCode}`	
38.	Ask the user how often and how long the wireless mouse or trackpad is used.	Yes	Go to step 39.	`\${nodeText.yesSymptomCode}`	
	Gain agreement from the user that lengthy wireless mouse or trackpad usage is likely to be the cause of the battery life issue, and that there is no service issue with the wireless mouse or trackpad itself.  Does the user agree that the battery life issue is likely caused by lengthy wireless device usage?	No	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K32	MOUSE

	Check	Result	Action	Code	Commodity
39.	Attempt to charge the user's wireless mouse or trackpad battery for several more minutes. Verify that the user's wireless mouse or trackpad battery charge level that appears on the known-good computer that is paired with this user's wireless mouse or trackpad has increased and shows that the user's wireless mouse or trackpad is charging.	Yes	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K31	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> <li>User's wireless mouse or trackpad battery will not charge</li> </ul> <p><b>Note:</b> This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless mouse or trackpad exhibit this symptom?</p>	No	Go to step 40.	<p> <code> </code> </p>	
40.	Closely inspect the user's wireless mouse or trackpad enclosure for signs of an expanded battery.	Yes	Replace the user's wireless mouse or trackpad.  Verify that the issue is resolved.	K33	MOUSE
	Confirm that the issue with the user's wireless mouse or trackpad is: <ul style="list-style-type: none"> <li>User's wireless mouse or trackpad battery appears expanded</li> </ul> <p><b>Note:</b> This symptom does not apply to peripherals with replaceable batteries.</p> <p>Does the user's wireless mouse or trackpad exhibit this symptom?</p>	No	Go to step 41.	<p> <code> </code> </p>	
41.	Isolate failure to either user's wireless mouse or wireless trackpad.	Wireless mouse	Go to step 42.	<p> <code> </code> </p>	
	Which peripheral is malfunctioning?	Wireless trackpad	Go to step 45.	<p> <code> </code> </p>	

	Check	Result	Action	Code	Commodity
42.	Verify that the overall function of the user's wireless mouse performs as expected when used with the known-good computer.	Yes	Replace the user's wireless mouse.  Verify that the issue is resolved.	K26	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> <li>No mouse response</li> </ul> Does the user's wireless mouse exhibit this symptom?	No	Go to step 43.	\${nodeText.noSymptomCode}	
43.	Verify that the clicking function of the user's wireless mouse performs as expected when pressed and released.	Yes	Replace the user's wireless mouse.  Verify that the issue is resolved.	K14	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> <li>Mouse clicking function not working properly</li> </ul> Does the user's wireless mouse exhibit this symptom?	No	Go to step 44.	\${nodeText.noSymptomCode}	
44.	Verify that the touch gesture function of the user's wireless mouse performs as expected when the mouse surface is touched.	Yes	Replace the user's wireless mouse.  Verify that the issue is resolved.	K18	MOUSE
	Confirm that the issue with the user's wireless mouse is: <ul style="list-style-type: none"> <li>Touch/Multi-Touch gesture issue</li> </ul> Does the user's wireless mouse exhibit this symptom?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	
45.	Verify that the overall function of the user's wireless trackpad performs as expected when used with the known-good computer.	Yes	Replace the user's wireless trackpad.  Verify that the issue is resolved.	K23	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> <li>Trackpad cursor not responding</li> </ul> Does the user's wireless trackpad exhibit this symptom?	No	Go to step 46.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
46.	Verify that the user's wireless trackpad exhibits smooth continuous tracking when used with the known-good computer, and does not skip or behave erratically.	Yes	Replace the user's wireless trackpad.  Verify that the issue is resolved.	K12	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> <li>Trackpad cursor not tracking properly</li> </ul> Does the user's wireless trackpad exhibit this symptom?	No	Go to step 47.	<code> \${nodeText.noSymptomCode} </code>	
47.	Verify that the clicking function of the user's wireless trackpad performs as expected when pressed and released, and that the click is recognized by the known-good computer.	Yes	Replace the user's wireless trackpad.  Verify that the issue is resolved.	K13	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> <li>Trackpad click not recognized</li> </ul> Does the user's wireless trackpad exhibit this symptom?	No	Go to step 48.	<code> \${nodeText.noSymptomCode} </code>	
48.	Verify that the user's wireless trackpad clicking function does not require excessive force when pressed and released.	Yes	Replace the user's wireless trackpad.  Verify that the issue is resolved.	K24	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> <li>Trackpad requires high click force</li> </ul> Does the user's wireless trackpad exhibit this symptom?	No	Go to step 49.	<code> \${nodeText.noSymptomCode} </code>	
49.	Verify that the user's wireless trackpad clicking function is not overly sensitive to clicking when pressed and released.	Yes	Replace the user's wireless trackpad.  Verify that the issue is resolved.	K25	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> <li>Trackpad click oversensitive</li> </ul> Does the user's wireless trackpad exhibit this symptom?	No	Go to step 50.	<code> \${nodeText.noSymptomCode} </code>	

	Check	Result	Action	Code	Commodity
50.	Verify that the user's wireless trackpad Force Touch function performs as expected and that haptic feedback is felt in response. Note: This feature does not apply to all models.	Yes	Replace the user's wireless trackpad.  Verify that the issue is resolved.	K29	MOUSE
	Confirm that the issue with the user's wireless trackpad is: <ul style="list-style-type: none"> <li>Trackpad Force Touch or haptic feedback issue</li> </ul> Does the user's wireless trackpad exhibit this symptom?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	

# External Apple Wired Keyboard and Mouse

## Unlikely causes:

There are no unlikely causes for this issue.

## Quick Check

Symptoms	Quick Check
<p>Apple wired USB keyboard or mouse does not function with user's computer or shows one or more of the following symptoms:</p> <ul style="list-style-type: none"><li>• One or more mouse buttons do not click</li><li>• Mouse scroll ball does not operate smoothly</li><li>• No mouse response</li><li>• Keys stick</li><li>• Keys loose or missing</li><li>• One or more keys do not respond when pressed</li><li>• No keyboard response at all</li><li>• Apple wired mouse causes erratic cursor tracking</li><li>• Apple wired keyboard or mouse is not recognized</li><li>• Apple wired keyboard or mouse has physical damage that affects operation</li><li>• Paint wearing off of one or more keys</li><li>• Apple wired keyboard or mouse has cosmetic damage that does not affect operation</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Disconnect all USB devices from the user's computer except for the user's mouse or keyboard. Troubleshoot only one device at a time to help isolate the issue.</li><li>2. Unplug the keyboard or mouse from the USB port, wait a few seconds, and reconnect it.</li><li>3. Connect the keyboard or mouse to another USB port on the user's computer.</li><li>4. Make sure the USB connectors are plugged in completely and correctly.</li><li>5. Visually inspect the USB connectors and ports for damage or debris.</li><li>6. Try operating the user's mouse on another surface. Ask the user about the type of surface usually being used with the mouse. Glossy or transparent surfaces, or those with repetitive patterns, may cause mouse-tracking errors or faulty mouse operation. Explain that solid, nonreflective, opaque surfaces work best. The surface should be clean, but not shiny.</li><li>7. Visually inspect the user's keyboard or mouse for dirt, hair, liquid damage, or other debris. Check to see if the user has pets. Pet hair can lie across the laser and cause intermittent mouse issues. Refer to <a href="#">HT204172: How to clean your Apple products</a> for information on cleaning the user's keyboard or mouse.</li><li>8. Connect the user's USB keyboard or mouse to an available USB port on a known-good computer to determine if the issue is related to the USB port on the user's computer, or to the user's USB keyboard or mouse. If the user's keyboard or mouse functions when used with the known-good computer, go to the "USB Port Not Recognized" troubleshooting flow.</li><li>9. For keyboard issues, refer to <a href="#">HT204540: If your Apple keyboard doesn't work</a> and <a href="#">HT203162: One or more keys on the keyboard do not respond</a> for troubleshooting tips.</li></ol>

## Deep Dive



	Check	Result	Action	Code	Commodity
1.	<p>Visually inspect the user's USB mouse or keyboard to verify that the attached USB cable and connector are not damaged or frayed.</p> <p>Check user's keyboard or mouse for physical and liquid damage.</p> <p>On mice, verify that all mouse buttons click and laser tracking LED illuminates.</p> <p>On keyboards, verify that all keys are present and can be depressed normally.</p> <p>Does the user's USB mouse or keyboard, or its attached cable or connector, show signs of damage?</p>	Yes	Go to step 2.	#{nodeText.yesSymptomCode}	
		No	Go to step 12.	#{nodeText.noSymptomCode}	
2.	<p>Isolate damage issue to either user's wired USB keyboard or mouse.</p> <p>Which peripheral is damaged?</p>	USB Keyboard	Go to step 3.	#{nodeText.yesSymptomCode}	
		USB Mouse	Go to step 9.	#{nodeText.noSymptomCode}	
3.	<p>Closely examine user's keyboard to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to keyboard.</p> <p>Is damage to user's keyboard related to liquid spill?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	KEYBOARD
		No	Go to step 4.	#{nodeText.noSymptomCode}	
4.	<p>Click each key to ensure no keys are sticking in the down or up position.</p> <p>Is damage to user's keyboard related to sticky keys or slow key response?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K05	KEYBOARD
		No	Go to step 5.	#{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
5.	Look for any loose or missing keycaps.  Is damage to user's keyboard related to loose or missing keycaps?	Yes	Replace USB keyboard. Verify issue resolved.  <b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K27	KEYBOARD
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	Closely inspect the keyboard for any signs of physical damage that may affect operation.  Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved.  <b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K16	KEYBOARD
		No	Go to Step 7.	\${nodeText.noSymptomCode}	
7.	Closely examine the keyboard for signs of paint wearing off of one or more keys.  Does the user's keyboard exhibit this symptom?	Yes	Replace USB keyboard. Verify issue resolved.  <b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.	K35	KEYBOARD
		No	Go to step 8.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
8.	<p>Closely inspect the keyboard for any signs of cosmetic damage that does not affect operation.</p> <p>Does the user's keyboard exhibit this symptom?</p>	Yes	<p>Replace USB keyboard. Verify issue resolved.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K21	KEYBOARD
		No	Issue cannot be duplicated.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
9.	<p>Closely examine user's mouse to determine exact nature of the issue.</p> <p>Look for any signs of liquid spill, liquid penetration, and liquid damage to mouse.</p> <p>Is damage to user's mouse related to liquid spill?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K90	MOUSE
		No	Go to step 10.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
10.	<p>Closely inspect the mouse for any signs of physical damage that may affect operation.</p> <p>Is there physical damage to user's mouse?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K16	MOUSE
		No	Go to step 11.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	

	Check	Result	Action	Code	Commodity
11.	<p>Closely inspect the mouse for any signs of cosmetic damage that does not affect operation.</p> <p>Is there cosmetic damage to user's mouse?</p>	Yes	<p>Replace USB mouse. Verify issue resolved.</p> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	K21	MOUSE
		No	Issue cannot be duplicated.	<p> <code> {\$nodeText.noSymptomCode} </code> </p>	
12.	<p>Isolate failure issue to either user's wired USB keyboard or mouse.</p> <p>Which peripheral is malfunctioning?</p>	USB Keyboard	Go to step 17.	<p> <code> {\$nodeText.yesSymptomCode} </code> </p>	
		USB Mouse	Gp to step 13.	<p> <code> {\$nodeText.noSymptomCode} </code> </p>	
13.	<p>Connect user's USB mouse to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the mouse.</p> <p>Is mouse recognized by a known-good computer?</p>	Yes	Go to step 14.	<p> <code> {\$nodeText.yesSymptomCode} </code> </p>	
		No	Replace USB mouse. Verify issue resolved.	K15	MOUSE
14.	<p>Move the mouse and verify that the cursor on the known-good computer screen moves smoothly.</p> <p>Is issue related to mouse function?</p>	Yes	Replace USB mouse. Verify issue resolved.	K26	MOUSE
		No	Go to step 15.	<p> <code> {\$nodeText.noSymptomCode} </code> </p>	
15.	<p>Click and roll the mouse's scroll ball to check that it rolls freely in all directions and with no physical resistance.</p> <p>Is issue related to the scroll ball?</p>	Yes	Replace USB mouse. Verify issue resolved.	K06	MOUSE
		No	Go to step 16.	<p> <code> {\$nodeText.noSymptomCode} </code> </p>	
16.	<p>Press the mouse's various buttons to verify that they click properly, without sticking, every time they are pressed.</p> <p>Is issue related to the mouse button(s)?</p>	Yes	Replace USB mouse. Verify issue resolved.	K14	MOUSE
		No	Issue cannot be duplicated.	<p> <code> {\$nodeText.noSymptomCode} </code> </p>	
17.	<p>Connect user's USB keyboard to a free USB port on a known-good computer, and check System Information to determine whether the computer recognizes the keyboard.</p> <p>Is keyboard recognized by a known-good computer?</p>	Yes	Go to step 18.	<p> <code> {\$nodeText.yesSymptomCode} </code> </p>	
		No	Replace USB keyboard. Verify issue resolved.	K15	KEYBOARD

	Check	Result	Action	Code	Commodity
18.	Verify that all keys functions as expected when pressed and released.	Yes	Replace USB keyboard. Verify issue resolved.	K01	KEYBOARD
	Is issue related to specific keys not working?	No	Go to step 19.	\${nodeText.noSymptomCode}	
19.	Verify that the keyboard language is as expected.	Yes	Replace USB keyboard. Verify issue resolved.	K04	KEYBOARD
	Is issue related to keyboard language?	No	Issue cannot be duplicated.	\${nodeText.noSymptomCode}	

# Internal Microphone Issues

## Unlikely causes:

Battery, eDP cable, fan, left speaker, memory, power supply, right speaker, stand, Wi-Fi/Bluetooth antennas.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Microphone not working, but audio output is functional.</li><li>• Microphone audio is garbled.</li><li>• Internal microphone input cannot be selected.</li><li>• Line audio input functions properly.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Identify the locations of all microphones (bottom front of display, and on upper-rear enclosure), and check that the microphone openings are not covered by tape, sticky notes, or other obstructions. Attempt to carefully remove any obstructions and verify this resolves the issue.</li><li>2. Go to System Preferences &gt; Sound, and verify the following:  Input tab:<ul style="list-style-type: none"><li>• Internal Microphone is available and selected for sound input.</li><li>• “Input volume” slider is not set to zero.</li></ul> Output tab:<ul style="list-style-type: none"><li>• Internal Speakers is available and selected for sound output.</li><li>• “Output volume” is not muted or set to zero.</li></ul></li><li>3. Go to System Preferences &gt; Sound &gt; Input tab, and verify that the “Input level” indicator moves when speaking into the microphone.</li><li>4. Check that no cables are inserted into the headphone jack. Use an otoscope to visually inspect jack. Use compressed air to clean and remove any debris.</li><li>5. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>6. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model.</li><li>7. Check for and apply the latest software and firmware updates.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Follow steps in <a href="#">Revive or restore Mac firmware in Apple Configurator 2</a> to revive the T2 firmware on the user's computer.</p> <p>Restart the computer and verify that it completely starts up to macOS.</p> <p>Retest by going to System Preferences &gt; Sound &gt; Input tab, and verifying that the input level indicator moves when speaking into the microphone.</p> <p>Does the issue persist after restoring T2 firmware?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	The issue was resolved by restoring T2 firmware.	`\${nodeText.noSymptomCode}`	
2.	<p>Disconnect any connected headphones or external speakers. Check whether System Preferences &gt; Sound &gt; Input tab shows an "Internal microphone" source available and selected.</p> <p>Does System Preferences list "External microphone" instead?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	<p>Debris in, or damage to, the headphone jack can cause the computer to become stuck in External Microphone input mode.</p> <p>Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.</p> <p>Use compressed air to clean and remove any debris.</p> <p>Is there any damage to the headphone jack?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify that the issue is resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>Contact CSS for additional support regarding warranty coverage for this part.</p>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	
4.	<p>Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker.</p> <p>Refer to <a href="#">TP587: Using Audio Test</a>.</p> <p>Does the computer pass AST 2 Audio test suite?</p>	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 5.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
5.	Follow Service Guide procedures to remove the display panel.	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
	<p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Remove the display panel.</p> <p>Locate and disconnect the front chin microphone flex cable from the logic board.</p> <p>Inspect both microphone openings to ensure they are not covered by incorrect installation of a VHB strip. If VHB is covering either microphone opening, follow service guide procedures to remove and install the correct VHB strip in that area.</p> <p>There are two microphone openings located along the lower inner side of the display panel opening in the front of the enclosure, and they are connected to the logic board with a small flex cable.</p> <p>Inspect the cable and connector on the logic board for any damage.</p> <p>Is there any damage to the cable or any connectors?</p>	No	Go to step 7.	\${nodeText.noSymptomCode}	
6.	Determine whether the damage is located on the microphone cable, the logic board, or a combination of multiple components.	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
	Is the damage limited to the logic board only?	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	Locate and disconnect the rear microphone flex cable from the logic board and the rear microphone assembly.	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
	Inspect the cable and connectors for any damage.  Is there any damage to the cable or any connectors?	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
8.	Determine whether the damage is located on the microphone cable, the microphone assembly, the logic board, or a combination of multiple components.	Yes	Replace the rear microphone cable.  Verify that the issue is resolved.	X03	INTERNAL CABLE
	Is the damage limited to the microphone cable only?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	
9.	Reseat the front microphone flex cable securely to the logic board.	Yes	The issue was resolved by reseating microphone cables. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Reseat the rear microphone flex cable securely to the logic board and rear microphone assembly.  Reassemble the computer.  Run AST 2 Audio Test suite to verify that built-in microphone detects expected audio test patterns produced from each speaker.  <a href="#">Refer to TP587: Using Audio Test.</a>  Does the computer pass AST 2 Audio test suite?	No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	Determine which component failed the diagnostic test:	A	Go to step 11.	`\${nodeText.yesSymptomCode}`	
	A. rear or front microphone, but not both B. both rear and front microphones  If the speaker tests failed, then return to the list of symptoms and select “No Audio from Internal Speakers or Headphone Jack” from the troubleshooting menu.  Which microphone failed the audio test?	B	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M09	MLB

	Check	Result	Action	Code	Commodity
11.	<p>Determine which component failed the diagnostic test:</p> <p>A. rear microphone B. front microphones</p> <p>Which microphone failed the audio test?</p>	A	<p>Replace the rear microphone cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		B	<p><b>ESCALATION REQUIRED.</b></p> <p>The front microphone assembly and flex cable, and the rear microphone assembly, are part of the rear enclosure. Replace the rear enclosure. Verify that the issue is resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>Contact CSS for additional support regarding warranty coverage for this part.</p>	<p>\$(nodeText.noSymptomCode)</p>	
12.	<p>Verify that the internal microphone is available, selected, and functional, and that the input level indicator moves when speaking into the microphone. Then record a sample audio file and play it back to verify that it is free of distortion.</p> <p>Run AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\$(nodeText.noSymptomCode)	

# No Audio from Internal Speakers or Headphone Jack

## Unlikely causes:

Battery, camera (some models), camera/microphone/ALS cable or camera cable, eDP cable, fan, hard disk drive (HDD) (some models), hard drive data or power or combo cable, display panel, memory, power supply, solid state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• No sound from headphone jack.</li><li>• No sound from left or right speakers.</li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Use controls to increase the sound volume to medium, halfway between minimum and maximum setting.</li><li>2. In System Preferences &gt; Sound &gt; Output, verify “Internal Speaker” output is available and selected.</li><li>3. Connect headphones or external speakers to the headphone jack. In System Preferences &gt; Sound &gt; Output, verify whether the Internal Speakers setting switches to Headphones, and whether audio can be played on headphones or external speakers.</li><li>4. Disconnect any device connected to the headphone jack. In System Preferences &gt; Sound &gt; Output, check that the sound output device reverts to Internal Speakers and that the Balance slider is set halfway between left and right.</li><li>5. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>6. Test the audio output using more than one application or website.</li><li>7. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model.</li><li>8. Check for and apply the latest software and firmware updates.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li><li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Identify the user's iMac model:  A. iMac Pro (2017), or other iMacs with the T2 Security Chip B. iMacs without the T2 Security Chip  Refer to <a href="#">HT208862: About the Apple T2 Security Chip</a> for more information.  Which iMac model?	A	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		B	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	Follow steps in <a href="#">Revive or restore Mac firmware in Apple Configurator 2</a> to revive the T2 firmware on the user's computer.  Restart the computer and verify that it completely starts up to macOS.  Retest for speaker or headphone jack audio issue.  Does the issue persist after restoring T2 firmware?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	The issue was resolved by restoring T2 firmware.	`\${nodeText.noSymptomCode}`	
3.	Start up the computer to a known-good external macOS startup volume.  Retest for speaker or headphone jack audio issue.  Does the issue persist with a known-good macOS?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Reinstall macOS on the user's computer.  Check for and apply the latest software and firmware updates.  Verify that the issue is resolved.	`\${nodeText.noSymptomCode}`	
4.	Disconnect any connected headphones or external speakers. Go to System Preferences > Sound > Output tab and verify that Internal Speaker is available and selected for sound output.  Does System Preferences list "Headphones" instead?	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 6.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
5.	<p>Debris in, or damage to, the headphone jack can cause the computer to become stuck in Headphone or External Speaker mode.</p> <p>Use a lighted otoscope or magnifying glass to inspect for damage or debris inside the jack.</p> <p>Use compressed air to clean and remove any debris.</p> <p>Is there any damage to the headphone jack?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>The headphone jack is part of the rear enclosure. Replace the rear enclosure. Verify that the issue is resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>Contact CSS for additional support regarding warranty coverage for this part.</p>	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
		No	Go to step 6.	<p> <code>\${nodeText.noSymptomCode}</code> </p>	
6.	<p>Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.</p> <p>Refer to <a href="#">TP587: Using Audio Test</a>.</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	<p>X99</p>	
	Does the computer pass AST 2 Audio Test suite?	No	Go to step 7.	<p> <code>\${nodeText.noSymptomCode}</code> </p>	
7.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Locate speaker connections on logic board. Disconnect and inspect both speaker cable connectors and corresponding connectors on logic board for damage.</p> <p>Reconnect the left and right speakers to the logic board, verifying that the connections are all seated properly.</p> <p>Did you find damage to speakers or logic board connector?</p>	Yes	Go to step 8.	<p> <code>\${nodeText.yesSymptomCode}</code> </p>	
		No	Go to step 9.	<p> <code>\${nodeText.noSymptomCode}</code> </p>	

	Check	Result	Action	Code	Commodity
8.	Determine whether damage is on the logic board, speakers, or both.	Yes	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.  Verify that the issue is resolved.	X08	OTHER ELECTRIC
	Is the damage limited to speakers?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	
9.	With speaker connectors reseated to logic board, verify you can hear audio through internal speakers.	Yes	The issue was resolved by reseating cables. Verify resolution.	\${nodeText.yesSymptomCode}	
	In System Preferences > Sound > Output tab, adjust Balance slider to check left and right speaker channel separation.  Play music with high and low tones to check bass and tweeter performance of left and right speakers.  <b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>  Do internal speakers present full range of expected audio performance?	No	Go to step 10.	\${nodeText.noSymptomCode}	
10.	Troubleshooting this issue completely requires a known-good left and right speaker set.	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
	Internal speakers are specified to work as a matched pair and must be tested or replaced as matched pairs.  Keep and identify your known-good speakers from one kit as a matched pair.  Do you have immediate access to a known-good speaker set?	No	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.  Verify that the issue is resolved.	X08	OTHER ELECTRIC



	Check	Result	Action	Code	Commodity
11.	Substitute a known-good internal speaker set and verify you can hear audio through internal speakers.	Yes	Speakers are replaced as a matched set. Replace speakers with a matched-pair replacement kit.  Verify that the issue is resolved.	X08	OTHER ELECTRIC
	Run AST or AST 2 Audio Test suite to verify that left and right speakers produce expected audio test patterns from each speaker.  Refer to <a href="#">TP587: Using Audio Test</a> .	No	Reinstall the user's speakers.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M09	MLB
	<b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>				
12.	Does unit pass Audio Test?				
	Connect and disconnect headphones/external speakers. Verify that audio can be played through both external and internal speakers, and that sound is clear and free of distortion.	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
	Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.  Is the issue resolved?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	

# No Audio to External Display Speakers

## Unlikely causes:

Battery, camera (some models), camera cable, fan, eDP cable, hard disk drive (HDD) (some models), HDD combo cable (some models), display panel, left speaker, memory, power supply, rear enclosure, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antennas wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> <li>Video but no audio to external display; audio works on internal speakers.</li> </ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> <li>Gather display type and model information from the user.</li> <li>Always use a known-good USB-C Digital AV Multiport Adapter and known-good HDMI display equipped with internal speakers to verify the issue. Review <a href="#">HT207443: Adapters for the Thunderbolt 3 or USB-C port on your Mac or iPad Pro</a> to help identify which adapters can be used with this computer model.</li> <li>In System Preferences &gt; Sound &gt; Output, select the available DisplayPort, Thunderbolt, HDMI, or USB output device type (the output name varies depending on the display model).</li> <li>On the HDMI display, verify that the correct input has been selected.</li> <li>Connect the video adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.</li> <li>Test the audio output using more than one application or website.</li> <li>Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li> <li>Reset the SMC using the procedure for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>. Retest for external audio issues.</li> <li>Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model.</li> <li>With the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter connected to the computer, check for and apply the latest software and firmware updates.</li> <li>Refer to the following to learn more about Thunderbolt connectivity in this computer: <ul style="list-style-type: none"> <li><a href="#">HT201853: Adapters for the Thunderbolt 3 or USB-C port on your Mac or iPad Pro</a></li> <li><a href="#">HT202488: About Apple Thunderbolt cables and adapters</a></li> </ul> </li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li><a href="#">TP833: Power Supply Cover Instructions</a></li> <li><a href="#">TP820: iMac (27-inch): Safety</a></li> <li><a href="#">TP914: iMac (21.5-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li><a href="#">TP1620: Power Supply Cover Instructions</a></li> <li><a href="#">TP1637: Safety</a></li> </ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p> <p>Check System Preferences &gt; Sound &gt; Output for an available DisplayPort output device type. Select the available device type, adjust the volume level on the display, and play the audio file or source.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Can the external display audio be selected and play audio in both plug orientations?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	<p>Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to the computer.</p> <p>Check System Preferences &gt; Sound &gt; Output for an available HDMI output device type. Select the available device type, adjust the volume level on the display, and play the audio file or source.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Can the external display audio be selected and play audio in both plug orientations?</p>	Yes	<p>The issue is isolated to the user's display or HDMI cable. Inform the user of findings and refer to <a href="#">HT204388: Connect to HDMI from your Mac</a> for more information.</p>	`\${nodeText.yesSymptomCode}`	
		No	<p>The issue is isolated to the user's adapter.</p> <p>Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter.</p> <p>If user has third-party adapter, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE
3.	<p>Start up the computer to a known-good external macOS startup volume.</p> <p>Check System Preferences &gt; Sound &gt; Output for an available DisplayPort, HDMI, or USB Output device type. Select the available device type, adjust the output volume level, and play the audio file or source.</p> <p>Can the external display audio be selected and play audio from a known-good macOS?</p>	Yes	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	<p>Inspect all USB-C receptacles and rear enclosure openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p><b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M09	MLB
5.	<p>Inspect the opening on the rear enclosure for the USB-C receptacle. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	X13	ENCLOSURE
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
6.	<p>Play a known-good audio file or source and verify that the sound output to display speakers is functional.</p> <p>Run AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	

# No Video on External Display

## Unlikely causes:

Battery, camera (some models), camera cable, fan, eDP cable, hard disk drive (HDD) (some models), HDD combo cable (some models), display panel, left speaker, memory, power supply, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ol style="list-style-type: none"> <li>1. External display is not detected when connected to computer.</li> <li>2. External display does not show any video.</li> </ol> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> <li>1. Gather display type and model information from the user.</li> <li>2. Always use a known-good USB-C Digital AV Multiport Adapter and known-good HDMI display equipped with internal speakers to verify the issue. Review <a href="#">HT207443: Adapters for the Thunderbolt 3 (USB-C) or USB-C port on your Mac or iPad Pro</a> to help identify which adapters can be used with this computer model.</li> <li>3. Refer to <a href="#">HT201177: Get help with video issues on external displays connected to your Mac</a> for common causes of video issues.</li> <li>4. On the HDMI display, verify that the correct input has been selected.</li> <li>5. Connect the video adapter to each USB-C connector on the computer and retest each time to isolate a possible faulty USB-C port on the user's computer.</li> <li>6. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li> <li>7. Reset the SMC using the procedure for this computer in <a href="#">HT201295: How to reset the SMC on your Mac</a>. Retest for external video issues.</li> <li>8. Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model.</li> <li>9. With the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter connected to the computer, check for and apply the latest software and firmware updates.</li> <li>10. Refer to the following to learn more about Thunderbolt connectivity in this computer: <ul style="list-style-type: none"> <li>• <a href="#">HT201853: Adapters for the Thunderbolt 3 or USB-C port on your Mac or iPad Pro</a></li> <li>• <a href="#">HT202488: About Apple Thunderbolt cables and adapters</a></li> </ul> </li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system is energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP833: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>

## Deep Dive



	Check	Result	Action	Code	Commodity
1.	<p>Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.</p> <p>Check System Preferences &gt; Displays for an available external HDMI display type. Select the available device type.</p> <p>Verify that the external display can be selected and that a good image appears on the external display.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Does a good image appear on the external display in both plug orientations?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	<p>Connect the known-good display and HDMI cable to the user's USB-C Digital AV Multiport Adapter, then to the computer.</p> <p>Check System Preferences &gt; Displays for an available external HDMI display type. Select the available device type.</p> <p>Verify that the external display can be selected and that a good image appears on the external display.</p> <p>Disconnect the USB-C plug, then flip it over and reconnect to test both orientations.</p> <p>Does a good image appear on the external display in both plug orientations?</p>	Yes	<p>The issue is isolated to the user's display or HDMI cable. Inform the user of findings and refer to <a href="#">HT204388: Connect to HDMI from your Mac</a> for more information.</p>	`\${nodeText.yesSymptomCode}`	
		No	<p>The issue is isolated to the user's adapter.</p> <p>Replace the user's USB-C Digital AV Multiport Adapter or USB-C Digital AV VGA Adapter.</p> <p>If user has third-party adapter, refer to manufacturer for support.</p>	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
3.	Connect the known-good display, HDMI cable, and USB-C Digital AV Multiport Adapter to the user's computer.	Yes	Reinstall macOS on the user's computer.	{nodeText.yesSymptomCode}	
	Start up the computer to a known-good external macOS startup volume.		Check for and apply the latest software and firmware updates.		
	Check System Preferences > Displays for an available external HDMI display type. Select the available device type.	No	Verify that the issue is resolved.	{nodeText.noSymptomCode}	
	Verify that the external display can be selected and that a good image appears on the external display.		Go to step 4.		
	Does a good image appear on the external display?				
4.	Inspect all USB-C receptacles and rear enclosure openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.  <b>Important:</b> Do not use any metal objects to clear debris or obstructions, as this can short the connector and cause damage.  Is any USB-C port damaged?	Yes	Go to step 5.	{nodeText.yesSymptomCode}	
		No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M26	MLB
5.	Inspect the opening on the rear enclosure for the USB-C receptacle. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plugs.  Is the opening for the USB-C port damaged or deformed?	Yes	Replace the rear enclosure.  Verify that the issue is resolved.	X13	ENCLOSURE
		No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M24	MLB

	Check	Result	Action	Code	Commodity
6.	Restart the computer and verify that a known-good external display works over both VGA and digital AV adapters.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>Run AST or AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	M99	

# USB Port Not Recognized

## Unlikely causes:

Battery, camera (some models), camera/microphone/ALS cable or camera cable, fan, eDP cable, hard disk drive (HDD) (some models), hard drive data or power or combo cable (some models), display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Standard USB devices are not recognized or not powered when connected to the computer.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>Disconnect all USB devices.</li><li>Verify that the user's USB device is compatible with the computer. Refer to <a href="#">HT201163: About USB on Mac computers</a> for more information about compatibility with various USB devices.</li><li>Verify that any USB hubs connected to the computer have sufficient power for a connected USB device.</li><li>Check to see whether the user's USB device requires a specific driver to function properly.</li><li>Check System Information &gt; USB device tree to see whether the computer recognizes internal USB devices (Bluetooth, IR, camera).</li><li>Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>Reset the SMC using the procedure for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>.</li><li>Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to verify system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li><li>Test each USB port using a known-good Apple wired keyboard or mouse.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Inspect USB ports for lint, debris, or other foreign material. Remove debris with an anti-static brush.	Yes	Issue resolved. Return computer to user, explaining that debris in USB port caused issue and what to do to prevent contamination in the future.	\$(nodeText.yesSymptomCode)	
	Is known-good Apple USB device functional and recognized?	No	Go to step 2.	\$(nodeText.noSymptomCode)	
2.	Inspect all USB receptacles and rear enclosure openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection.	Yes	Go to step 3.	\$(nodeText.yesSymptomCode)	
	Is any USB port damaged?	No	Go to step 4.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
3.	<p>Inspect the opening on the rear enclosure for the USB receptacle. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB plugs.</p> <p>Is the opening for the USB port damaged or deformed?</p>	Yes	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	X13	ENCLOSURE
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
4.	<p>Disconnect all USB devices. Verify whether known-good Apple wired keyboard or mouse functions correctly and is recognized in System Information &gt; USB device tree.</p> <p>Is known-good Apple USB device functional and recognized?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 5.	\${nodeText.noSymptomCode}	
5.	<p>Continue to use known-good Apple wired keyboard or mouse.</p> <p>Start up the computer to a known-good external macOS startup volume.</p> <p>Verify whether known-good USB device functions correctly and is recognized in System Information &gt; USB device tree.</p> <p>Is a known-good Apple USB device functional and recognized?</p>	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M15	MLB

	Check	Result	Action	Code	Commodity
6.	Start up the computer to macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	Issue resolved by directory repair in Disk Utility. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<p>Use Disk Utility to repair the user's internal flash storage volume.</p> <p>Restart computer to internal flash storage volume.</p> <p>Verify whether a known-good USB device functions correctly and is recognized in System Information &gt; USB device tree.</p> <p>Is known-good Apple USB device functional and recognized?</p>	No	<p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Verify that the issue is resolved.</p>	`\${nodeText.noSymptomCode}`	
7.	<p>This computer can support one high-powered USB device (iPad, iPhone, or USB hard drive for example) at a time.</p> <p><b>Note:</b> The first USB device to draw more than 900 mA is allotted up to 1100 mA, while all subsequent devices are limited to 900 mA. See <a href="#">HT204377: If a Mac accessory needs more power or is using too much power</a> for more information.</p> <p>Do you have immediate access to a known-good, high-powered USB device that draws over 900 mA?</p>	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	
8.	<p>Connect known-good, high-powered USB device to one of the computer's USB ports. In System Information &gt; USB device tree, "Current Available (mA)" and "Extra Operating Current (mA)" should each report 900 mA.</p> <p><b>Note:</b> The first USB device to draw more than 900 mA is allotted up to 1100 mA, while all subsequent devices are limited to 900 mA. Verify that known-good USB device functions as expected.</p> <p>Does "Extra Operating Current" appear in System Information?</p>	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M38	MLB

	Check	Result	Action	Code	Commodity
9.	Connect exact same high-powered USB device to next USB port. Verify that nothing is plugged into other ports. Both “Current Available (mA)” and “Extra Operating Current (mA)” should each report 900 mA in System Information. Repeat action with every available USB port.  <b>Note:</b> The first USB device to draw more than 900 mA is allotted up to 1100 mA, while all subsequent devices are limited to 900 mA. Verify USB device operates as expected.  Does “Extra Operating Current” appear in System Information?	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`	MLB
		No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M38	
10.	Try user’s USB device with a known-good computer. Verify whether it functions normally and is recognized in System Information > USB device tree.  Is user’s USB device functional and recognized?	Yes	Issue resolved by testing USB ports and verifying user’s USB device. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	Advise user to do the following: <ul style="list-style-type: none"> <li>• Contact USB device manufacturer for support.</li> <li>• Verify system requirements and Mac compatibility.</li> <li>• Find out whether device requires additional software.</li> </ul>	`\${nodeText.noSymptomCode}`	
11.	Confirm that a known-good USB device is functional and recognized.  Check System Information for correct power allocation to USB device.  Run AST or AST 2 Full System Diagnostic (EFI & OS), if available, to ensure no other issues remain.  Verify that the issue is resolved.  Is issue resolved?	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	M99	



# USB-C and Thunderbolt Connectivity Issues

## Unlikely causes:

Battery, camera (some models), camera cable, fan, eDP cable, hard disk drive (HDD) (some models), HDD combo cable (some models), display panel, left speaker, memory, power supply, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> <li>Standard USB-C devices are not recognized or not powered when connected to computer's USB-C ports.</li> <li>USB 2 or USB 3 devices are not recognized or not powered when connected to computer's USB-C ports.</li> <li>External DisplayPort or Thunderbolt devices or displays are not recognized when connected to computer's USB-C ports.</li> </ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> <li>Verify that any USB hubs connected to the computer have sufficient power for a connected USB device.</li> <li>Check whether the user's USB device requires a specific driver to function properly.</li> <li>If the user is using a USB 3 device, review <a href="#">HT201163: About USB on Mac computers</a>.</li> <li>Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li> <li>Reset the SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a> to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do. Retest for USB-C connectivity issues.</li> <li>Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to check that the system build is correct for this computer model.</li> <li>Using a Wi-Fi network, check for and apply the latest software and firmware updates. Also check for adapter firmware updates by leaving the user's adapter connected to the computer while running software update. If an update is available, update the adapter's firmware before proceeding further, and retest for USB-C connectivity issues.</li> <li>Refer to the following articles to learn more about Thunderbolt connectivity in this computer: <ul style="list-style-type: none"> <li><a href="#">HT207443: Adapters for the Thunderbolt 3 or USB-C port on your Mac or iPad Pro</a></li> <li><a href="#">HT206909: Networking two Mac computers directly with a Thunderbolt 3 cable requires Thunderbolt-enabled hosts</a></li> <li><a href="#">HT207113: Daisy chaining USB 2.0 devices to Thunderbolt 3 (USB-C) ports</a></li> </ul> </li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li><a href="#">TP833: Power Supply Cover Instructions</a></li> <li><a href="#">TP820: iMac (27-inch): Safety</a></li> <li><a href="#">TP914: iMac (21.5-inch): Safety</a></li> </ul> <p>For iMac Pro (2017) refer to:</p> <ul style="list-style-type: none"> <li><a href="#">TP1620: Power Supply Cover Instructions</a></li> <li><a href="#">TP1637: Safety</a></li> </ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Inspect all USB-C ports and top case openings on the user's computer for any signs of deformation, damage, or debris that may be blocking the connection. Use compressed air to clear any obstructions or debris.</p> <p>If possible, also inspect the electromagnetic interference (EMI) springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p><b>Important:</b> Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
2.	<p>Inspect the opening on the rear enclosure for the USB-C receptacle. Determine whether the opening is misshapen or deformed, preventing proper insertion of the USB-C plugs.</p> <p>Is the opening for the USB-C port damaged or deformed?</p>	Yes	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	X13	ENCLOSURE
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
3.	<p>Using an Apple USB-C to USB Adapter, connect a known-good high-speed USB (1.1/2.0) device, such as a mouse, keyboard, or USB 2 flash drive to the same USB-C port on the computer.</p> <p>Verify in System Information &gt; USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 11.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File &gt; Refresh Information from the menu bar.</p> <p>Verify in System Information &gt; USB that the device is detected.</p> <p>Is the USB 1.1/2.0 device detected?</p>	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	Go to step 11.	\${nodeText.noSymptomCode}	
5.	<p>Using a known-good Apple USB-C to USB Adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive to the same USB-C port on the computer.</p> <p>Verify in System Information &gt; USB that the device is detected.</p> <p>Is the USB 3 device detected?</p>	Yes	Go to step 6.	\${nodeText.yesSymptomCode}	
		No	Go to step 11.	\${nodeText.noSymptomCode}	
6.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File &gt; Refresh Information from the menu bar.</p> <p>Verify in System Information &gt; USB that the device is detected.</p> <p>Is the USB 3 device detected?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	Go to step 11.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
7.	<p>Using the user's Apple USB-C to USB Adapter in place of the known-good adapter, connect a known-good USB 3 device, such as a USB 3 hard drive or flash drive to the same USB-C port on the computer.</p> <p>Refer to <a href="#">HT207443: Adapters for the Thunderbolt 3 or USB-C port on your Mac or iPad Pro</a> for more information about Apple USB-C adapters.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File &gt; Refresh Information from the menu bar.</p> <p>Verify in System Information &gt; USB that the device is detected.</p> <p>Test both orientations.</p> <p>Is the USB 3 device detected?</p>	Yes	Go to step 8.	<code>\${nodeText.yesSymptomCode}</code>	
		No	<p>Replace the user's Apple USB-C adapter.</p> <p>If the adapter is made by a third party, advise the user to contact the manufacturer for support.</p> <p>Verify that the issue is resolved.</p>	X03	EXTERNAL CABLE
8.	<p>Using a known-good Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.</p> <p>Verify in System Information &gt; Thunderbolt that the device is detected.</p> <p>Refer to <a href="#">HT207266: About the Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter</a> for more information about this adapter.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to step 9.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Go to step 14.	<code>\${nodeText.noSymptomCode}</code>	
9.	<p>Disconnect and flip the orientation of the USB-C Apple adapter cable plug, then reconnect it to the same USB-C port on the computer and retest, to test both orientations.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File &gt; Refresh Information from the menu bar.</p> <p>Verify in System Information &gt; Thunderbolt that the device is detected.</p> <p>Is the Thunderbolt 2 device detected?</p>	Yes	Go to step 10.	<code>\${nodeText.yesSymptomCode}</code>	
		No	Go to step 14.	<code>\${nodeText.noSymptomCode}</code>	

	Check	Result	Action	Code	Commodity
10.	Using the user's Apple Thunderbolt 3 (USB-C) to Thunderbolt 2 Adapter in place of the known-good adapter, connect a known-good external Thunderbolt 2 device such as a display or external disk to the same USB-C port on the computer.	Yes	Go to "No Video on External Display" troubleshooting flow.	X03	EXTERNAL CABLE
	<p>Refer to <a href="#">HT207443: Adapters for the Thunderbolt 3 or USB-C port on your Mac or iPad Pro</a> for more information about Apple USB-C adapters.</p> <p>Refresh the USB Device Tree in System Information by pressing Command-R, or by choosing File &gt; Refresh Information from the menu bar.</p> <p>Verify in System Information &gt; Thunderbolt that the device is detected.</p> <p>Test both orientations.</p> <p>Is the Thunderbolt 2 device detected?</p>	No	<p>Replace the user's Apple USB-C adapter.</p> <p>If the adapter is made by a third party, advise the user to contact the manufacturer for support.</p> <p>Verify that the issue is resolved.</p>		
11.	<p>Inspect all USB-C ports on the computer for any visible damage or debris that may be preventing a connection.</p> <p>Also inspect the EMI springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Clear any debris as necessary.</p> <p><b>Important:</b> Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p> <p>Is any USB-C port damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
	Is any USB-C port damaged?	No	Go to step 12.		

	Check	Result	Action	Code	Commodity
12.	Determine if the following symptom was observed on the user's computer: <ul style="list-style-type: none"> <li>• USB device not detected.</li> </ul> Does this symptom accurately describe the user's issue?	Yes	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M37	MLB
		No	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Determine if the following symptom was observed on the user's computer: <ul style="list-style-type: none"> <li>• USB port has insufficient power.</li> </ul> Does this symptom accurately describe the user's issue?	Yes	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M38	MLB
		No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M15	MLB

	Check	Result	Action	Code	Commodity
14.	<p>Inspect all USB-C ports on the computer for any visible damage or debris that may be preventing a connection.</p> <p>Also inspect the EMI springs on each USB-C connector to ensure they are not bent or otherwise damaged.</p> <p>Clear any debris as necessary.</p> <p><b>Important:</b> Do not use any metal objects to clear debris or obstructions as this can short the connector and cause damage.</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
	Is any USB-C port damaged?	No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> <li>Thunderbolt display functionality issue.</li> </ul> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M32	MLB
		No	Go to step 16.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
16.	<p>Determine if the following symptom was observed on the user's computer:</p> <ul style="list-style-type: none"> <li>Thunderbolt not providing enough power.</li> </ul> <p>Does this symptom accurately describe the user's issue?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M34	MLB
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M33	MLB
17.	<p>Confirm that known-good USB high-speed and SuperSpeed devices and Thunderbolt devices are functional and recognized when connected to all USB-C ports on the computer, in both orientations.</p> <p>Run AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	<p>The issue is resolved.</p> <p>Verify resolution.</p>	<p>\${nodeText.yesSymptomCode}</p>	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	

# Flash Storage Not Recognized, Not Mounting, or Read/Write Issues

## Unlikely causes:

Battery, fan, eDP cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antennas.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Displays flashing folder with question mark or prohibitive symbol.</li><li>Cannot save documents.</li><li>Displays read or write error messages.</li><li>Hangs when accessing or saving data.</li><li>Drive or volume is not recognized in Disk Utility (icon is grayed out).</li><li>Cannot erase volume, and bootable drive is not shown in Disk Utility.</li></ul>	<p><b>Important:</b> Always ask if the user's data has been backed up before beginning the repair.</p> <ol style="list-style-type: none"><li>Disconnect all peripherals and attempt to start up the computer.</li><li>To restore the default startup disk, reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>Reset SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a> to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li><a href="#">TP833: Power Supply Cover Instructions</a></li><li><a href="#">TP820: iMac (27-inch): Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Connect a known-good Apple wired keyboard and Apple wired mouse to user's computer.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>Press the power button to start up the computer.</p> <p>Confirm that computer completes the startup process: Apple logo &gt; progress indicator &gt; login screen &gt; desktop or installer screen.</p> <p>During startup, allow up to four minutes for a defective flash storage to time out, after which the computer will start up from a known-good external device.</p> <p>Does the computer start up completely?</p>	No	Return to the list of symptoms and select the "Will Not Start Up" troubleshooting flow.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
2.	Run AST 2 Storage Diagnostic suite on the user's computer and examine the results of the test.  Do all internal drive tests pass in Storage Diagnostic?	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	H99	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Examine Storage Diagnostic results for presence of an internal drive.  Did drive presence test PASS or FAIL?	Pass	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		Fail	Go to step 12.	`\${nodeText.noSymptomCode}`	
4.	Examine Storage Diagnostic results for SMART status.  Did SMART test PASS or FAIL?	Pass	Go to step 5.	`\${nodeText.yesSymptomCode}`	
		Fail	Go to step 12.	`\${nodeText.noSymptomCode}`	
5.	Examine Storage Diagnostic results for Short Random Multi-Block Read Test.  Did Short Random Multi-Block Read Test PASS or FAIL?	Pass	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		Fail	Go to step 12.	`\${nodeText.noSymptomCode}`	
6.	Examine Storage Diagnostic results for File System Check.  Did File System Check PASS or FAIL?	Pass	Go to step 7.	`\${nodeText.yesSymptomCode}`	
		Fail	Go to step 9.	`\${nodeText.noSymptomCode}`	
7.	Examine Storage Diagnostic results for Bootable Volume Presence Check.  Did Bootable Volume Check PASS or FAIL?	Pass	Go to step 8.	`\${nodeText.yesSymptomCode}`	
		Fail	Go to step 9.	`\${nodeText.noSymptomCode}`	
8.	Examine Storage Diagnostic results for Last OS Reinstall Check.  Did Last OS Reinstall Check PASS or FAIL?	Pass	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	H99	
		Fail	Go to step 9.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
9.	Start up the computer to macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
	<p>Use Disk Utility to repair the user's internal flash storage volume.</p> <p>Attempt to start up the user's computer from its internal flash storage.</p> <p>Does the computer start up successfully from the user's internal flash storage?</p>	No	Go to step 10.	`\${nodeText.noSymptomCode}`	
10.	Start up the computer to macOS Recovery. Run Disk Utility and select the user's flash storage drive.	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
	<p>Erase the flash storage drive using Mac OS Extended (Case-sensitive, Journaled) format and GUID Partition Map scheme.</p> <p>Erase the flash storage drive again using Mac OS Extended (Journaled) format and GUID Partition Map scheme.</p> <p>Formatting the drive twice with different partition map schemes will force a rewrite of the partitions table.</p> <p>Reinstall macOS on the user's computer.</p> <p>Check for and apply the latest software and firmware updates.</p> <p>Does the computer start up successfully from the user's internal flash storage?</p>	No	Go to step 12.	`\${nodeText.noSymptomCode}`	
11.	Run AST Storage Diagnostic on the user's computer again and examine the results of the test.	Yes	The issue was resolved by repairing the flash storage volume. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Does the computer pass all internal drive tests?	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	H99	

	Check	Result	Action	Code	Commodity
12.	<p><b>Note:</b> Consult AST 2 diagnostic results to verify whether the logic board contains a flash storage card. If the logic board does not contain a flash storage card, reply 'NO' to this step and the next step, to replace the logic board.</p> <p>Follow Service Guide procedures to remove the display panel and logic board to gain access to the flash storage card.</p> <p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Look for damage on both logic board and flash storage connectors.</p> <p>Did you find damage to flash storage or logic board connectors?</p>	Yes	<p>Replace the logic board, which includes a new paired flash storage card (for configurations with an existing flash storage card.)</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 13.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
		Yes	Issue resolved by reseating flash storage. Verify resolution.	<p> <code>           \${nodeText.yesSymptomCode}         </code> </p>	
		No	<p>Replace the logic board, which includes a new paired flash storage card (for configurations with an existing flash storage card.)</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M19	MLB
13.	<p>Reconnect user's flash storage. Verify that the flash storage card is properly seated to the logic board connector.</p> <p><b>Note:</b> The flash storage card in this model is paired to the logic board, and must not be exchanged with any other flash storage card or the computer will not start up. Refer to the Service Guide for more information.</p> <p>Run AST Storage Diagnostic suite on the user's computer again and examine the results of the test.</p> <p>Do all internal drive tests pass in Storage Diagnostic?</p>	No			
		Yes			

	Check	Result	Action	Code	Commodity
14.	Confirm that the computer can successfully start up from internal flash storage.	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
	<p>Run AST 2 Full System Diagnostic (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	H99	

# SD Memory Card Cannot Be Inserted Into Slot

## Unlikely causes:

Battery, camera (some models), camera/microphone/ALS cable or camera cable, fan, eDP cable, hard disk drive (HDD) (some models), HDD data or power or combo cable (some models), display panel, left speaker, memory, power supply, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Cannot insert SD card into slot.</li><li>• Can insert SD card only part way into slot.</li><li>• Card slot does not align with enclosure.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Check that the user's SD card is not warped or damaged, and that the metal contacts are clean, intact and corrosion-free.</li><li>2. Verify that the SD card is the correct size. Card dimensions should be 32 mm x 24 mm x 2.1 mm.</li></ol> <p><b>Note:</b> Cards thicker than 2.1 mm are too thick and may damage the card slot if inserted. Thinner cards such as MultiMediaCards (MMC) are acceptable. Refer to <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> for further information.</p> <ol style="list-style-type: none"><li>3. Verify that the computer's SD card slot is not obstructed in any way. Use a flashlight to look into slot to verify nothing is already inserted. If so, carefully remove the obstruction from the slot. Try to reinsert the SD card.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li><li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Insert known-good, formatted SD card into user's computer. Verify that it seats correctly.</p> <p>Does known-good SD card seat correctly when inserted?</p>	Yes	<p>Issue resolved. Defective or incompatible SD card. Advise user to contact SD card vendor for support. Refer them to <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> for further information.</p>	<p> <code>           \${nodeText.yesSymptomCode}         </code> </p>	
		No	Go to step 2.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
2.	<p>Inspect the SD card opening on the rear enclosure. Determine whether the opening is misshapen or deformed, preventing proper insertion of SD cards.</p> <p>Is the opening for the SD card damaged or deformed?</p>	Yes	<p>Replace the rear enclosure.</p> <p>Verify that the issue is resolved.</p>	<p>X13</p>	ENCLOSURE
		No	Go to step 3.	<p> <code>           \${nodeText.noSymptomCode}         </code> </p>	
3.	<p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.</p> <p>Remove display panel.</p> <p>Remove chin strap to avoid bending or damaging it while aligning logic board.</p> <p>Loosen but do not remove all logic board screws. You should be able to shift board position slightly, both left to right and up and down. Take care to avoid damaging cabling or other components while moving logic board.</p> <p>Insert known-good SD card again.</p> <p>Can you now insert known-good SD card correctly?</p>	Yes	Go to step 4.	<p> <code>           \${nodeText.yesSymptomCode}         </code> </p>	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	<p>M27</p>	MLB



	Check	Result	Action	Code	Commodity
4.	<p>Hold the logic board in position and tighten all logic board screws. Insert the known-good SD card again.</p> <p>Can you now insert and remove known-good SD card correctly?</p>	Yes	Issue resolved with logic board alignment. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M27	MLB
5.	<p>Verify that a known-good SD memory card can be fully inserted into and ejected from slot and that it seats correctly.</p> <p>Run AST or AST 2 Full System Diagnostic (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	`\${nodeText.yesSymptomCode}`	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	M99	

# SD Memory Card Not Recognized

## Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, fan, DisplayPort cable, hard disk drive (HDD), HDD data or power or combo cable, display panel, left speaker, memory, power supply, rear enclosure, right speaker, solid-state drive (SSD) / flash storage card, stand, Wi-Fi/Bluetooth antenna(s), wireless card

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>SD card does not appear on desktop or in System Information</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>Make sure the SD card is unlocked.</li><li>Check that the user's SD card is not warped or damaged and that the metal contacts are clean, intact, and corrosion free.</li><li>Verify that the computer's SD card slot is not damaged or obstructed. Use a flashlight to inspect the slot to make sure nothing is already inserted. If so, carefully remove the obstruction from the slot. Try to reinsert the SD card.</li><li>Verify that the SD card is the correct size. Card dimensions should be 32 mm x 24 mm x 2.1 mm.  <b>Note:</b> Cards thicker than 2.1 mm are too thick and may damage card slot if inserted. Thinner cards such as MultiMediaCards (MMC) are acceptable. Refer to <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> for further specifications.</li><li>Consult <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> and check for compatible SD card type and format.<ul style="list-style-type: none"><li>SD card slot can accommodate cards that are Standard SD (Secure Digital) 4MB to 2GB, SDHC (Secure Digital High Capacity) 4GB to 32GB, and SDXC (Secure Digital Extended Capacity) 4GB to 2TB. MMC cards can also be used in this slot.</li><li>While SDIO (Secure Digital Input Output) cards fit into and should not damage the card slot, they are not supported.</li><li>MiniSD and Micro SD cards require adapters.</li></ul></li><li>For a more specific SD card type or format (wireless-enabled SD card or other SD card for example), make sure the correct driver is installed. macOS supports only standard SD memory cards; other cards may require specific driver software.</li><li>Make sure Finder Preferences &gt; General is set to show External Disks.</li><li>Refer to <a href="#">HT201260: Find out which macOS your Mac is using</a> to make sure system build is correct for this computer model. Check for and apply the latest software and firmware updates.</li><li>Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li><li>Reset the SMC using the procedure for this computer in <a href="#">HT201295: How to reset the System Management Controller (SMC) on your Mac</a>.</li></ol>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Insert a known-good, formatted SD card into user's computer. Verify that card seats correctly.  Does known-good SD card seat correctly when inserted?	Yes	Go to step 2.	\$(nodeText.yesSymptomCode)	
		No	Go to "SD Memory Card Cannot Be Inserted Into Slot" troubleshooting flow.	\$(nodeText.noSymptomCode)	
2.	Verify that a known-good SD card appears in Disk Utility and mounts in Finder. Verify that computer can read data from and write data to card.  Can computer read from and write to known-good SD card?	Yes	Go to step 4.	\$(nodeText.yesSymptomCode)	
		No	Go to step 3.	\$(nodeText.noSymptomCode)	
3.	Use one of the following two methods to start up the computer to a known-good macOS.  Start up the computer to Internet Recovery. See <a href="#">HT201314: About macOS Recovery</a> .  Start up the computer to a known-good external macOS startup volume.  Verify that a known-good SD card appears and mounts in Disk Utility.  Repair permissions and directory using Disk Utility. If issue persists, Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates.  Retest to verify resolution.  Can computer now read from and write to known-good SD card?	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	Replace the logic board, which includes SD card reader.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system. Failure to do so may result in an inoperative system and an incomplete repair.  Verify that the issue is resolved.	M27	MLB
4.	Insert user's SD card into user's computer. Verify that it seats correctly.  Does user's SD card seat correctly when inserted?	Yes	Go to step 5.	\$(nodeText.yesSymptomCode)	
		No	Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> for further information.	\$(nodeText.noSymptomCode)	
5.	Verify that SD card appears in left column of Disk Utility. If card does not appear, eject and reinsert card. If inserted too slowly, card may not appear.  Does SD card appear in Disk Utility?	Yes	Go to step 7.	\$(nodeText.yesSymptomCode)	
		No	Go to step 6.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
6.	Insert user's SD card into a known-good computer. Verify that computer can read data from and write data to SD card.	Yes	Repair permissions and directory using Disk Utility. If issue persists, Reinstall macOS on the user's computer. Check for and apply the latest software and firmware updates.  Retest to verify resolution.	`\${nodeText.yesSymptomCode}`	
	Can a known-good computer read from and write to user's SD card?	No	Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> for further information.	`\${nodeText.noSymptomCode}`	
7.	Verify that user's SD card volume appears in Disk Utility and mounts in Finder.	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
	Does card volume mount in Finder or Disk Utility?	No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	Format user's SD Card as macOS Extended Journaled with a GUID partition scheme.	Yes	Issue resolved by reformatting SD card. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<b>Important:</b> Make sure user has a valid backup first. If formatting is successful, retest SD card by writing data to and retrieving data from card.  Were you able to reformat, then write to and read from the card successfully?	No	Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> for further information.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
9.	<p>Test user's SD card by writing data to and retrieving data from card.</p> <p>Were you able to write to and read from user's card successfully?</p>	Yes	<p>Verify issue resolved.</p> <p>If the issue persists, contact ACS for additional support.</p>	M99	
		No	<p>Defective or incompatible SD card. Advise user to contact SD card manufacturer for support. Refer user to <a href="#">HT204384: About the SD and SDXC card slot on your Mac</a> for further information.</p>	\${nodeText.noSymptomCode}	
10.	<p>Verify that user's computer can successfully read from and write to a known-good SD card.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact ACS for additional support or a multipart repair.</p>	M99	

# Burning Smell or Odor

## Unlikely causes:

There are no unlikely causes for this issue.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Computer emits a burning, smoky, or other unusual odor.</li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>Disconnect all third-party devices to eliminate external devices as source of odor.</li><li>Inspect the enclosure and components for obvious signs of burning or smoky residue. Check the rear vents, slots, ports, and power cord.</li><li>Clean the enclosure to eliminate any causes due to external contamination.</li><li>Verify that the vents allow unobstructed airflow into and out of the computer.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li><a href="#">TP833: Power Supply Cover Instructions</a></li><li><a href="#">TP820: iMac (27-inch): Safety</a></li><li><a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li><a href="#">TP1620: Power Supply Cover Instructions</a></li><li><a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>Determine whether this is a safety issue.</p> <p>Do not perform procedures that can be a safety risk to you or the user.</p> <p>Have you identified a safety issue?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for safety-related issues. Refer to <a href="#">OP44: Handling Potential Product Safety Issues</a>.</p> <p>Retail: Document the issue and escalate following the steps in <a href="#">RS60: Product Safety Escalations</a>.</p>	<p>\${nodeText.yesSymptomCode}</p>	
		No	Go to step 2.	<p>\${nodeText.noSymptomCode}</p>	
2.	<p>An odor can be related to external contamination. Inspect the computer exterior for contamination or lack of cleanliness.</p> <p>Can you determine that the odor is caused by external contamination?</p>	Yes	Go to step 3.	<p>\${nodeText.yesSymptomCode}</p>	
		No	Go to step 4.	<p>\${nodeText.noSymptomCode}</p>	
3.	<p>Thoroughly clean enclosure and all external surfaces. Refer to <a href="#">HT204172: How to clean your Apple products</a>. Explain the cause to the user.</p> <p>Does user agree that the odor is due to external contamination?</p>	Yes	The issue is resolved. Verify resolution.	<p>\${nodeText.yesSymptomCode}</p>	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	<p>X99</p>	
4.	<p>Odors can be related to product newness. Refer to <a href="#">HT202324: Odors may be present short-term</a>.</p> <p>Can you determine that the odor is due to the product being new?</p>	Yes	Go to step 5.	<p>\${nodeText.yesSymptomCode}</p>	
		No	Go to step 6.	<p>\${nodeText.noSymptomCode}</p>	

	Check	Result	Action	Code	Commodity
5.	<p>Explain to the user that new computers can sometimes emit an odor, similar to odors generated from new carpeting or a new car. In most cases, the odor dissipates after a brief period.</p> <p>Does the user agree that the odor is related to the computer being new?</p>	Yes	The issue is resolved. Verify resolution.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	
6.	<p>Closely inspect internal components and the enclosure for indications of physical damage or contamination.</p> <p>Can you identify signs of internal damage or contamination?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 7.	`\${nodeText.noSymptomCode}`	
7.	<p>Refer to <a href="#">TP1150: Visual/Mechanical Inspection (VMI) Guide for Mac Liquid Damage</a> for guidance regarding possible liquid damage to the user’s computer.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	Go to the “Mechanical, Physical, or Cosmetic Damage” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	<p>Closely inspect internal hardware and the enclosure for other possible causes of odor, such as bulging or vented chip capacitors, or visible residue or burn marks on the enclosure, logic board, or other components.</p> <p>Have you identified a component failure as the source of the odor?</p>	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	
		No	The issue cannot be duplicated.	`\${nodeText.noSymptomCode}`	
9.	<p>Run the computer for several hours and monitor for the issue or odor. Run the full system diagnostics available in AST or AST 2. If no functional failure is detected, use correct positioning to explain to the user that the odor is related to external contamination or the computer being new.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	



# Computer Runs Hot

## Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, eDP cable, hard drive data or power or combo cable (some models), left speaker, memory, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> <li>• Computer feels unusually warm.</li> <li>• Fan is not operating.</li> <li>• Fan is not functioning to its full capacity.</li> <li>• Fan runs constantly at high speeds.</li> </ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> <li>1. Run Mac Resource Inspector (MRI) diagnostic suite to verify correct operation of sensors and fan.</li> <li>2. Check for and apply latest software and firmware updates.</li> <li>3. Inspect fan performance during operation to verify fan is spinning. Check that vents are not blocked, and if necessary, use compressed air to remove dust or debris from rear fan exhaust.</li> <li>4. Compare computer's operating temperature to a known-good, similarly configured computer.</li> <li>5. Check for runaway applications using the information in <a href="#">HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity</a>. Follow the instructions to halt any processes that are using excessive system resources.</li> <li>6. Processor-intensive or graphics-intensive applications and system processes may cause the enclosure to feel warm. Use Activity Monitor to identify these types of programs and explain issue to user.</li> <li>7. Reset SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a> to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.</li> <li>8. Verify that computer's internal hard drive or flash storage is an Apple-installed part. Compare hard drive information in System Information to the Apple Hard Drives Matrix in <a href="#">SM155: Hard Drives Matrix</a> to determine whether user's installed drive is one of OEM drives available for this computer configuration. Third-party hard drives without correct firmware or thermal sensors, or outside this computer's specifications, may cause computer to run hot or permanently activate fan at full speed. In such cases, inform user that computer has been modified from its original, supported configuration, and that such a repair would not be covered under Apple warranty.</li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP833: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> <li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Run Mac Resource Inspector (MRI) diagnostic suite and consult diagnostic results to check for fan (motor) or sensor failures.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	<p>An inoperative or clogged fan can cause the computer to run hot.</p> <p>Sensors that indicate they are out of normal operating range can help isolate why the computer is running hot.</p> <p>Does computer pass all MRI checks?</p>	No	Go to step 8.	`\${nodeText.noSymptomCode}`	
2.	Use extended version of Cooling System Diagnostics (CSD) to verify proper function of the following subsystems: <ul style="list-style-type: none"> <li>• SMC</li> <li>• Fan</li> <li>• Thermal sensors</li> <li>• CPU–heat sink thermal interface</li> </ul> <p>Does computer pass all CSD tests?</p>	Yes	Computer passed all CSD tests. Verify operation and refer user to <a href="#">HT202179: About fans and fan noise in your Apple product.</a>	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	<p>Remove display panel.</p> <p>Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseat fan cable connections to logic board. Reassemble and retest with CSD.</p> <p><b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b></p> <p>Does computer pass all CSD checks?</p>	No	Go to step 4.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	<p>Troubleshooting this issue completely requires a known-good fan.</p> <p>Do you have immediate access to known-good fan?</p>	Yes	Go to step 5.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the fan.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC
5.	<p>Substitute a known-good fan and retest using MRI and CSD.</p> <p>Does computer now pass MRI and CSD tests?</p>	Yes	<p>Replace the fan.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC
		No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	<p>Troubleshooting this issue completely requires a known-good logic board.</p> <p>Do you have immediate access to a known-good logic board?</p>	Yes	Go to step 7.	\${nodeText.yesSymptomCode}	
		No	<p>Reinstall user's fan.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
7.	<p>Continue to use known-good fan. Substitute a known-good logic board. Reassemble computer and retest with MRI.</p> <p>Do both known-good fan and logic board pass MRI and run-in tests?</p>	Yes	<p>Reinstall user's fan.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M18	MLB
		No	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P17	POWER SUPPLY

	Check	Result	Action	Code	Commodity
8.	Determine specific type of failure reported in diagnostics:  A. thermal or fan sensor B. voltage or current sensor  <ul style="list-style-type: none"> <li>MRI thermal sensors begin with Txxx.</li> <li>MRI electrical voltage sensors begin with Vxxx.</li> <li>MRI electrical current sensors begin with Ixxx.</li> </ul> Which sensor failure does diagnostics report?	A	Go to step 15.	`\${nodeText.yesSymptomCode}`	
		B	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.  Remove display panel.  Some power-related sensors are located in power supply, but are read through a SMBus connection to logic board.  <b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>  Does MRI report a VDxx or IDxx test failure?	Yes	Go to step 10.	`\${nodeText.yesSymptomCode}`	
		No or Other	Go to step 13.	`\${nodeText.noSymptomCode}`	
10.	Reseat DC power cable connection to logic board. Reassemble and retest, using MRI.  Does MRI still report a VDxx or IDxx sensor test failure?	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved by reseating DC power cable connection between power supply and logic board. Verify resolution.	`\${nodeText.noSymptomCode}`	
11.	Troubleshooting this issue completely requires a known-good power supply.  Do you have immediate access to a known-good power supply?	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
		No	DC power cable is part of power supply.  Replace the power supply.  Verify that the issue is resolved.	P17	POWER SUPPLY

	Check	Result	Action	Code	Commodity
12.	Substitute a known-good power supply, reassemble and retest using MRI.  Does MRI still report a VDxx or IDxx sensor test failure?	Yes	Reinstall user's power supply.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M18	MLB
		No	DC power cable is part of power supply.  Replace the power supply.  Verify that the issue is resolved.	P17	POWER SUPPLY
13.	Most voltage and current regulators are located on logic board. Troubleshooting this issue completely requires a known-good logic board.  Do you have immediate access to a known-good logic board?	Yes	Go to step 14.	\$_{nodeText.yesSymptomCode}	
		No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M18	MLB

	Check	Result	Action	Code	Commodity
14.	Substitute a known-good logic board, reassemble and retest using MRI.  Does MRI still report a Vxxx or lxxxx sensor test failure?	Yes	Reinstall the user's logic board.  Replace the power supply.  Verify that the issue is resolved.	P17	POWER SUPPLY
		No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M18	MLB
15.	Determine specific type of failure reported in diagnostics: thermal sensor or fan (motor) error.  MRI thermal sensors begin with Txxx.  Which sensor failure does diagnostics report?	Thermal	Go to step 22.	\$_{nodeText.yesSymptomCode}	
		Fan (Motor)	Go to step 16.	\$_{nodeText.noSymptomCode}	
16.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.  Remove display panel.  Refer to the service guide Functional Overview to locate affected fan connection to logic board. Disconnect fan cable connectors and inspect logic board and fan cable connector pins for damage.  Is there any cable or connector damage on fan or logic board?	Yes	Go to step 17.	\$_{nodeText.yesSymptomCode}	
		No	Go to step 19.	\$_{nodeText.noSymptomCode}	
17.	Identify whether fan, logic board, or both are damaged.  Are both fan and logic board damaged?	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\$_{nodeText.yesSymptomCode}	
		No	Go to step 18.	\$_{nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
18.	Identify whether fan or logic board is damaged.  Which part is damaged?	Fan	Replace the fan.  Verify that the issue is resolved.	X22	OTHER ELECTRIC
		Logic Board	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M24	MLB
19.	Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with MRI.  <b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>  Does computer pass fan motor check?	Yes	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 20.	\${nodeText.noSymptomCode}	
20.	Troubleshooting this issue completely requires a known-good fan.  Do you have immediate access to a known-good fan?	Yes	Go to step 21.	\${nodeText.yesSymptomCode}	
		No	Replace the fan.  Verify that the issue is resolved.	X22	OTHER ELECTRIC



	Check	Result	Action	Code	Commodity
21.	Substitute a known-good fan, and retest using MRI.  Does computer now pass fan motor check?	Yes	Replace the fan.  Verify that the issue is resolved.	X22	OTHER ELECTRIC
		No	Reinstall user's fan.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M08	MLB
22.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.  Remove display panel.  Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with MRI.  <b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>  Does MRI still report a Txxx thermal sensor test failure?	Yes	Go to step 23.	\${nodeText.yesSymptomCode}	
		No	Issue resolved by cleaning fan and heat sink and resealing fan connections. Verify resolution.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
23.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the logic board.</p> <p>Refer to service documentation for information about thermal sensors.</p> <p>Is a logic board thermal sensor failing a test?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
		No	Go to step 24.	`\${nodeText.noSymptomCode}`	
24.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the Hard Disk Drive (HDD) or Flash Storage.</p> <p><b>Note:</b> Some models do not have a HDD.</p> <p>Is a hard drive or flash storage thermal sensor failing a test?</p>	Yes	Go to step 25.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 29.	`\${nodeText.noSymptomCode}`	
25.	<p>Verify in <a href="#">SM155: Hard Drives Matrix</a> that the installed hard drive or flash storage model is compatible with this computer configuration.</p> <p>Is installed HDD or flash storage compatible with this model?</p>	Yes	Go to step 26.	`\${nodeText.yesSymptomCode}`	
		No	Unsupported HDD or Flash Storage installed, or missing/incorrect hard drive thermal sensor. Check with user for out-of-warranty resolution. Verify resolution.	`\${nodeText.noSymptomCode}`	
26.	<p>Identify the type of storage device affected:</p> <ul style="list-style-type: none"> <li>• Hard Disk Drive (HDD)</li> <li>• Flash Storage</li> </ul> <p>Is the affected device an HDD or flash storage?</p>	HDD	Go to step 27.	`\${nodeText.yesSymptomCode}`	
		Flash Storage	<p>Replace the user's flash storage.</p> <p>Verify that the issue is resolved.</p>	H85	SSD
27.	<p>Troubleshooting this issue completely requires a known-good hard drive data cable or hard drive combo cable (depending on model).</p> <p>Do you have immediate access to a known-good hard drive data cable or hard drive combo cable?</p>	Yes	Go to step 28.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the user's hard drive.</p> <p>Verify that the issue is resolved.</p>	H85	HDD

	Check	Result	Action	Code	Commodity
28.	Substitute a known-good hard drive data cable or hard drive combo cable (depending on model) and retest using MRI.	Yes	Replace the user's hard drive data cable or hard drive combo cable (depending on model).  Verify that the issue is resolved.	X03	INTERNAL CABLE
	Does computer now pass the THxx sensor check?	No	Reinstall the user's hard drive data cable or combo cable (depending on model). Replace the user's hard drive.  Verify that the issue is resolved.	H85	HDD
29.	Identify whether a thermal sensor that is currently failing MRI test is related to the power supply.	Yes	Replace the power supply.  Verify that the issue is resolved.	P17	POWER SUPPLY
	Is a power supply thermal sensor failing a test?	No	Go to step 30.	`\${nodeText.noSymptomCode}`	
30.	Identify whether a thermal sensor that is currently failing MRI test is related to the display.  Is a display thermal sensor failing a test?	Yes	Go to step 31.	`\${nodeText.yesSymptomCode}`	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	M99	
31.	Troubleshooting this issue completely requires a known-good display panel.  Do you have immediate access to a known-good display panel?	Yes	Go to step 32.	`\${nodeText.yesSymptomCode}`	
		No	Replace the display panel.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	L85	LCD

	Check	Result	Action	Code	Commodity
32.	Substitute a known-good display panel and retest using MRI.  Does MRI still report a TL0p or TL1p thermal sensor test failure?	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.yesSymptomCode}	
		No	Replace the display panel.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	L85	LCD
33.	Use Cooling System Diagnostic to verify that the computer is running within thermal specifications.  Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.  Verify that the issue is resolved.  Is the issue resolved?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	M99	

# Mechanical, Physical, or Cosmetic Damage

## Unlikely causes:

There are no unlikely causes for this issue.

## Quick Check

Symptoms	Quick Check
<p>The computer shows signs of physical or cosmetic damage such as:</p> <p>Enclosure and stand:</p> <ul style="list-style-type: none"><li>• Stand hinge is loose or broken.</li><li>• Stand is bent, loose, or broken.</li><li>• Screw is stripped, loose, or missing.</li><li>• Scratches.</li><li>• Dents.</li><li>• Cracks.</li><li>• Liquid spill.</li></ul> <p>Display Assembly:</p> <ul style="list-style-type: none"><li>• Broken glass.</li><li>• Cracked display panel.</li><li>• Scratches.</li><li>• Dents.</li><li>• Liquid spill.</li></ul> <p><b>Note:</b> Inform the user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>1. Inspect the computer and discuss the nature of the issue with the user. Determine whether the user wants to proceed with the repair (despite possible accidental damage) or pursue other service options. Click “No” to proceed with further troubleshooting.</li><li>2. Refer to <a href="#">TP1151: Visual/Mechanical Inspection (VMI) Guide for Mac - Table of Contents</a> damage to the user's computer.</li><li>3. Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</li></ol> <p><b>Note:</b> For input device issues, including damage, go to the “External Apple Bluetooth Peripherals” or “External Apple Wired Keyboard and Mouse” troubleshooting flows.</p>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine the cause of damage or defects: user, technician, environment, accidental damage, or abuse.	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for assistance with Apple-related accidental damage.	X99	
	Is an Apple technician responsible for the damage or defect on the computer?	No	Go to step 2.	`\${nodeText.noSymptomCode}`	
2.	Closely examine the user's computer for signs of enclosure damage, such as: <ul style="list-style-type: none"><li>• Stand hinge is loose or broken.</li><li>• Screw is stripped, loose, or missing.</li><li>• Stand is bent, loose, or broken.</li></ul>	Yes	Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).  Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.	X12	ENCLOSURE
	Does the computer exhibit this type of damage?	No	Go to step 3.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
3.	<p>Closely examine the user's computer for signs of enclosure damage, such as:</p> <ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> <li>Cracks</li> </ul> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	X13	ENCLOSURE
		No	Go to step 4.	\$(nodeText.noSymptomCode)	
4.	<p>Closely examine the user's computer enclosure for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's enclosure.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	X90	ENCLOSURE
		No	Go to step 5.	\$(nodeText.noSymptomCode)	
5.	<p>Closely examine the user's computer for signs of display damage, such as a cracked, dented, or broken display frame or assembly housing.</p> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	L18	LCD
		No	Go to step 6.	\$(nodeText.noSymptomCode)	
6.	<p>Closely examine the user's computer display panel for signs of cosmetic damage, such as:</p> <ul style="list-style-type: none"> <li>Scratches</li> <li>Dents</li> </ul> <p>Does the computer exhibit this type of damage?</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	L19	LCD
		No	Go to step 7.	\$(nodeText.noSymptomCode)	

	Check	Result	Action	Code	Commodity
7.	<p>Closely examine the user's computer display panel for signs of a single hairline crack.</p> <p>A single hairline crack is one continuous curved or straight crack. It may travel across the whole screen or cover a small area.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	L35	LCD
	Does the computer exhibit this type of damage?	No	Go to step 8.	\${nodeText.noSymptomCode}	
8.	<p>Closely examine the user's computer display panel for signs of multiple cracks.</p> <p>Two or more glass cracks, or two or more hairline cracks, count as multiple cracks.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	L36	LCD
	Does the computer exhibit this type of damage?	No	Go to step 9.	\${nodeText.noSymptomCode}	
9.	<p>Closely examine the user's computer display panel for signs of liquid spill damage.</p> <p>Look for any signs of liquid spill, liquid penetration, or liquid damage to the computer's display panel.</p>	Yes	<p>Proceed with repair creation to see available options. Inform the user that computer failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan (APP).</p> <p>Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> for details.</p>	L90	LCD
	Does the computer exhibit this type of damage?	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for assistance with Apple-related accidental damage.</p>	\${nodeText.noSymptomCode}	

# Noise, Hum, or Vibration

## Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, eDP cable, hard disk drive (HDD) (some models), hard drive data or power or combo cable (some models), display panel, left speaker, logic board, memory, rear enclosure, right speaker, solid-state drive (SSD)/flash storage card, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Buzzing noise.</li><li>• Rattling noise.</li><li>• Ticking noise.</li><li>• Squeaking noise.</li><li>• Humming noise.</li><li>• High frequency noise.</li><li>• Mechanical vibration.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"><li>1. Work with the user to reproduce the issue and isolate the source of noise. Differentiate whether the noise is coming from the computer or a connected peripheral. Disconnect all third-party peripherals to isolate the source of noise.</li><li>2. Determine whether the sound is normal or abnormal. Refer to <a href="#">TS3204: Evaluating System noises</a> for more information.</li><li>3. If the iMac fan runs at full speed after the computer turns on, you may need to reset the iMac's SMC. Refer to <a href="#">HT204463: If the fans in your Mac run at full speed when you turn it on</a> and <a href="#">HT202179: About fans and fan noise in your Apple product</a> for more information. Reset SMC using procedure listed for this computer in HT201295: How to reset the SMC of your Mac.</li><li>4. Verify that the vents on the bottom and back of the computer are free of dust and other obstructions that might inhibit proper airflow through the computer.</li><li>5. Launch Applications &gt; Utilities &gt; Activity Monitor. Determine whether an application or process is consuming a high percentage of CPU bandwidth. CPU-intensive applications can cause fan to run fast in order to maintain proper internal computer temperatures. If needed, quit application or restart the computer to resolve issue.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with Power Supply Covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP833: Power Supply Cover Instructions</a></li><li>• <a href="#">TP820: iMac (27-inch): Safety</a></li><li>• <a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li><li>• <a href="#">TP1637: Safety</a></li></ul>

## Deep Dive



	Check	Result	Action	Code	Commodity
1.	Disconnect any peripheral devices, cards, or cables attached to computer.	Yes	Issue resolved. Issue caused by ground loop induced by third-party devices. Advise user to connect all devices to a common power outlet or contact device manufacturer for support.	\${nodeText.yesSymptomCode}	
	Has noise been eliminated?	No	Go to step 2.	\${nodeText.noSymptomCode}	
2.	Tilt display to hinge limits to determine whether mechanical noise is generated by hinge mechanism.	Yes	Go to “Stand or Hinge Issues” troubleshooting flow.	\${nodeText.yesSymptomCode}	
	Is noise coming from iMac's display hinge?	No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.	Yes	Replace the power supply.  Verify that the issue is resolved.	P04	POWER SUPPLY
	Remove display panel.  Connect computer to AC power and listen carefully around power supply to verify whether it is source of noise.  <b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>	No	Go to step 4.	\${nodeText.noSymptomCode}	
	Is noise coming from iMac's power supply?				

	Check	Result	Action	Code	Commodity
4.	Shut down computer. If you reinstalled display panel, remove it.	Yes	Issue resolved by removing loose objects inside chin area.	\$(nodeText.yesSymptomCode)	
	Hold computer firmly with both hands and invert computer while gently shaking it, to attempt to dislodge and remove any loose screws or other foreign objects that may have fallen down inside the computer into the chin area.				
	Loose objects in the chin area can cause noise or vibration, especially during audio playback.	No	Go to step 5.	\$(nodeText.noSymptomCode)	
	Briefly retest for noise, hum, or vibration.				
5.	Has noise been eliminated?				
	Shut down computer and let it cool off fully. Check for noise, hum or vibration during startup when computer is cold.	Yes	Go to step 6.	\$(nodeText.yesSymptomCode)	
	Does issue happen on or after a cold startup?	No	Go to step 12.	\$(nodeText.noSymptomCode)	
6.	An unreadable thermal sensor can cause fan to run excessively. Run Mac Resource Inspector diagnostic suite (MRI) to check thermal sensors.	Yes	Go to “Computer Runs Hot” troubleshooting flow.	\$(nodeText.yesSymptomCode)	
	Does MRI report any thermal sensor failures?	No	Go to step 7.	\$(nodeText.noSymptomCode)	
7.	Excessive fan operation may also occur if computer is unable to read fan speed. Check MRI results for fan (motor) sensor test results.	Yes	Go to step 8.	\$(nodeText.yesSymptomCode)	
	Does MRI report any fan (motor) failures?	No	Go to step 10.	\$(nodeText.noSymptomCode)	
8.	Troubleshooting this issue completely requires a known-good fan.	Yes	Go to step 9.	\$(nodeText.yesSymptomCode)	
	Do you have immediate access to known-good fan?	No	Replace the fan. Verify that the issue is resolved.	X23	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
9.	Substitute known-good fan and retest with MRI.  Does known-good fan pass fan (motor) test in MRI?	Yes	Replace the fan.  Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Reinstall user's fan.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M23	MLB
10.	Disconnect fan and briefly retest for noise, hum, or vibration.  Has noise been eliminated?	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	Go to step 12.	\${nodeText.noSymptomCode}	
11.	Verify whether any tape, gasket, cable label, cable, or other material is touching fan blades and causing a ticking or buzzing noise. Secure material so it does not touch fan blades. If tape adhesive has lost its stickiness, replace that section of tape.	Yes	Issue resolved by securing internal components or material to prevent touching fan blades. Verify resolution.	\${nodeText.yesSymptomCode}	
	Remove fan and rotate blades. Verify that fan blades spin smoothly without interference from fan housing, cables, tape, gaskets or other components.	No	Replace the fan.	X23	OTHER ELECTRIC
	Reinstall fan while carefully ensuring that there are no cables routed under or near fan assembly that might cause interference with fan blades. After reassembling computer, verify whether noise issue is resolved.		Verify that the issue is resolved.		
12.	Depending on configuration, there may or may not be a hard drive installed. Other configurations may have either a flash storage card or both flash storage and HDD.  Is a hard drive installed in computer?	Yes	Go to step 13.	\${nodeText.yesSymptomCode}	
		No	Go to step 14.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
13.	<b>Note:</b> Verify that the user's computer can access the Internet before performing this step.  Disconnect the internal hard drive.  Start up the computer to Internet Recovery. See <a href="#">HT201314: About macOS Recovery</a> .  Has noise been eliminated?	Yes	Go to "HDD Noisy" troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 14.	`\${nodeText.noSymptomCode}`	
14.	Play sound sample at loud and soft volume levels to determine whether noise is caused by left or right speakers or amplifier circuit. Plug in external headphones to identify whether noise comes from audio out or from other source. Mute computer volume. Verify whether issue still occurs.  Has noise been eliminated?	Yes	Go to "Distorted Audio from Internal Speakers" troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 15.	`\${nodeText.noSymptomCode}`	
15.	Troubleshooting this issue completely requires a known-good fan.  Do you have immediate access to a known-good fan?	Yes	Go to step 16.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 17.	`\${nodeText.noSymptomCode}`	
16.	Substitute known-good fan and retest.  Has noise been eliminated?	Yes	Replace the fan.  Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Go to step 18.	`\${nodeText.noSymptomCode}`	
17.	Disconnect fan and briefly retest for noise, hum, or vibration.  Has noise been eliminated?	Yes	Replace the fan.  Verify that the issue is resolved.	X23	OTHER ELECTRIC
		No	Go to step 18.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
18.	<p>With hard drive and fan disconnected, briefly retest once again while listening closely for any noise, hum, or vibration coming from logic board and heat sink assembly.</p> <p>Inspect logic board and heat sink assembly for any damage that may have occurred during removal or replacement.</p> <p>Logic board and heat sink assembly must be treated as a single unit during removal or replacement. All screws must be removed from both components prior to physically pulling or pushing either component.</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
	<p>Any mishandling of heat sink assembly that is attached to logic board can cause damage to heat pipes connecting these components.</p> <p>If heat pipes become even slightly damaged (bent or kinked for example), normal heat removal cycle can become disrupted, causing a repetitive hammering noise from this area. Damage may not be visibly noticeable.</p> <p>Noise may be mistaken for a faulty hard drive. Check for this noise with hard drive and fan disconnected.</p> <p>Is there noise coming from logic board and heat sink assembly?</p>	No	Go to step 19.	<p>\$(nodeText.noSymptomCode)</p>	
19.	<p>Noise may be related to interference from other electrical devices operating near computer or plugged into same power outlet. See whether noise is eliminated when computer runs in a different location on a different circuit.</p> <p>Has noise been eliminated?</p>	Yes	Issue resolved.	\$(nodeText.yesSymptomCode)	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	

	Check	Result	Action	Code	Commodity
20.	Confirm that the computer's noise, hum, or vibration has been eliminated.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	<p>If help is needed, record a sample audio file to review with CSS.</p> <p>Run AST or AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Verify that the issue is resolved.</p> <p>Is the issue resolved?</p>	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	M99	

# Stand or Hinge Issues

## Unlikely causes:

There are no unlikely causes for this issue.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>Bent stand.</li><li>Broken hinge.</li><li>Stripped screw head.</li><li>Stripped screw boss or threads.</li><li>Loose stand or hinge.</li></ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"><li>Inspect the computer and discuss the nature of issue with the user. Determine whether the user wants to proceed with repair (despite possible accidental damage) or pursue other service options.</li><li>Click “No” to proceed with further troubleshooting.</li></ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"><li><a href="#">TP833: Power Supply Cover Instructions</a></li><li><a href="#">TP820: iMac (27-inch): Safety</a></li><li><a href="#">TP914: iMac (21.5-inch): Safety</a></li></ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"><li><a href="#">TP1620: Power Supply Cover Instructions</a></li><li><a href="#">TP1637: Safety</a></li></ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Determine cause of damage or defects: user, technician, environment, accidental damage, or abuse.	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for assistance with Apple-related accidental damage.	X99	
	Is an Apple agent responsible for damage or defect on the computer?	No	Go to step 2.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
2.	<p>Inspect stand to determine whether it requires replacement.</p> <p>Verify that stand securely holds computer in its upright position without wobbling when placed on a hard, smooth, even surface.</p> <p>Is stand damaged or defective?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Replace the stand. Verify that the issue is resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>Contact CSS for additional support regarding warranty coverage for this part.</p>	X99	
		No	Go to step 3.	\${nodeText.noSymptomCode}	
3.	<p>Inspect hinge mechanism to determine whether it requires replacement.</p> <p>Adjust computer back and forth on its hinge, listening for hinge noise. Check feel of the hinge. Its movement should feel firm—not tight or loose—as it holds the iMac in position. Hinge should operate smoothly along its entire travel.</p> <p>Is hinge mechanism damaged or defective?</p>	Yes	<p>Replace the hinge mechanism. Verify that the issue is resolved.</p> <p>Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p>	X12	PIECE PART
		No	Go to step 4.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
4.	Place the customer's iMac on a solid, flat surface.	Yes	<b>ESCALATION REQUIRED.</b>  Replace the rear enclosure. Verify that the issue is resolved.  Inform user that failures due to accidental damage are not covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a> .  Contact CSS for additional support regarding warranty coverage for this part.	X99	
	Have another person apply downward pressure to the stand to hold it down on that solid surface.  Firmly grasp both sides of the iMac enclosure, and gently attempt to rotate the entire enclosure left and right while facing the display. The enclosure should not be able to move in this direction.				
5.	Compare this behavior with a known-good, similar iMac model.	No	Go to step 5.	\${nodeText.noSymptomCode}	
	If the enclosure rotates an abnormal amount, the mechanism mounts inside the rear enclosure may no longer be securely attached, which may require a rear enclosure replacement.  Does the iMac's enclosure rotate an abnormal amount?				
6.	Place the user's iMac on a solid, flat surface and check if one side of the display appears to sit higher or lower than the other side.	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	
	Does one side of the iMac appear to sit higher or lower than the other side?	No	Go to step 6.	\${nodeText.noSymptomCode}	
6.	Verify that both stand and hinge operate properly and that they securely hold the iMac upright in all appropriate positions.	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
	Is the issue resolved?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	

# Intermittent Shutdown

## Unlikely causes:

Battery, camera, camera/microphone/ALS cable or camera cable, eDP cable, left speaker, memory, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antennas, wireless card (some models).

## Quick Check

Symptoms	Quick Check
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- Shuts down during startup.
- Shuts down unexpectedly during use.
- Computer restarts spontaneously.
- Turns off when waking from sleep.

**Note:** Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.

**Note:** Verify the issue after using the computer for a few minutes to warm it, or by following steps in [HT207571: Warm a Mac for testing](#). Doing this may help identify intermittent issues.

1. Run AST or AST 2 Mac Resource Inspector diagnostic suite (MRI) to verify correct operation of sensors and fan.
2. Check for and apply latest software and firmware updates.
3. Inspect fan performance during operation to verify that fan is spinning. Check that vents are not blocked, and if necessary, use compressed air to remove dust or debris from rear fan exhaust.
4. Compare computer's operating temperature to a known-good, similarly configured computer.
5. Check for runaway applications using the information in [HT203184: See how apps affect Mac performance, battery runtime, temperature, and fan activity](#). Follow the instructions to halt any processes that are using excessive system resources.
6. Hold down the Shift key during startup to put the computer into safe mode. Refer to [HT201262: How to use safe mode on your Mac](#).
7. Start up the computer to macOS Recovery. See [HT201314: About macOS Recovery](#).
8. Reset the NVRAM using the procedure for this computer in [HT204063: Reset NVRAM or PRAM on your Mac](#).
9. Reset SMC using the procedure listed for this computer in [HT201295: How to reset the SMC of your Mac](#) to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.
10. Verify that computer's internal hard drive or flash storage is an Apple-installed part. Compare hard drive information in System Information to the Apple Hard Drives Matrix in [SM155: Hard Drives Matrix](#) to determine whether user's installed drive is one of OEM drives available for this computer configuration. Third-party hard drives without correct firmware or thermal sensors, or outside this computer's specifications, may cause computer to run hot or permanently activate fan at full speed. In such cases, inform user that computer has been modified from its original, supported configuration, and that such a repair would not be covered under Apple warranty.

**Warning:** Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.

Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.

For additional safety information and tips, refer to:

- [TP833: Power Supply Cover Instructions](#)
- [TP820: iMac \(27-inch\): Safety](#)
- [TP914: iMac \(21.5-inch\): Safety](#)

For iMac Pro (2017), refer to:

- [TP1620: Power Supply Cover Instructions](#)
- [TP1637: Safety](#)

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Power and thermal issues can cause intermittent shutdowns. Run AST or AST 2 Mac Resource Inspector diagnostic suite (MRI) to check for problems detected by sensors.	Yes	Go to step 2.	`\${nodeText.yesSymptomCode}`	
	Sensors that indicate they are out of normal operating range or an inoperative fan can cause intermittent shutdowns.  Does computer pass all MRI checks?	No	Go to step 5.	`\${nodeText.noSymptomCode}`	
2.	Start up the user's computer from its normal startup volume.	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	Attempt to reproduce shutdown symptoms.  Can you reproduce the shutdown event?	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	Start up the computer to Internet Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M08	MLB
	Attempt to reproduce shutdown symptoms.  Does shutdown issue persist?	No	Reinstall macOS on the user's computer.  Check for and apply the latest software and firmware updates.  Verify that the issue is resolved.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
4.	Run AST or AST 2 extended memory test suite, if available, repeatedly to verify that the computer does not unexpectedly shut down.  Did computer shut down unexpectedly?	Yes	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M08	MLB
		No	No failure found during repeated diagnostic testing. Using correct positioning, return computer to user with no trouble found. Verify that the issue is resolved.	\${nodeText.noSymptomCode}	
5.	Determine specific type of failure reported in diagnostics:  A. thermal or fan sensor B. voltage or current sensor  <ul style="list-style-type: none"> <li>MRI thermal sensors begin with Txxx.</li> <li>MRI electrical voltage sensors begin with Vxxx.</li> <li>MRI electrical current sensors begin with Ixxx.</li> </ul> Which sensor failure does diagnostics report?	A	Go to step 12.	\${nodeText.yesSymptomCode}	
		B	Go to step 6.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
6.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.  Remove display panel.  Some power-related sensors are located in power supply, but are read through a SMBus connection to logic board.  <b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>  Does MRI report a VDxx or IDxx test failure?	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
		No or Other	Go to step 10.	`\${nodeText.noSymptomCode}`	
7.	Reseat DC power cable connection to logic board. Reassemble and retest, using MRI.  Does MRI still report a VDxx or IDxx sensor test failure?	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved by reseating DC power cable connection between power supply and logic board. Verify resolution.	`\${nodeText.noSymptomCode}`	
8.	Troubleshooting this issue completely requires a known-good power supply.  Do you have immediate access to a known-good power supply?	Yes	Go to step 9.	`\${nodeText.yesSymptomCode}`	
		No	DC power cable is part of power supply.  Replace the power supply.  Verify that the issue is resolved.	P02	POWER SUPPLY

	Check	Result	Action	Code	Commodity
9.	<p>Substitute a known-good power supply, reassemble and retest using MRI.</p> <p>Does MRI still report a VDxx or IDxx sensor test failure?</p>	Yes	<p>Reinstall user's power supply.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M08	MLB
		No	<p>DC power cable is part of power supply.</p> <p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P02	POWER SUPPLY
10.	<p>Most voltage and current regulators are located on logic board. Troubleshooting this issue completely requires a known-good logic board.</p> <p>Do you have immediate access to a known-good logic board?</p>	Yes	Go to step 11.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M08	MLB

	Check	Result	Action	Code	Commodity
11.	Substitute a known-good logic board, reassemble and retest using MRI.  Does MRI still report a Vxxx or Ixxx sensor test failure?	Yes	Reinstall user's logic board.  Replace the power supply.  Verify that the issue is resolved.	P02	POWER SUPPLY
		No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M08	MLB
12.	Determine specific type of failure reported in diagnostics: thermal sensor or fan (motor) error.  MRI thermal sensors begin with Txxx.  Which sensor failure does diagnostics report?	Thermal	Go to step 19.	\${nodeText.yesSymptomCode}	
		Fan (Motor)	Go to step 13.	\${nodeText.noSymptomCode}	
13.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.  Remove display panel.  Refer to the service guide Functional Overview to locate affected fan connection to logic board. Disconnect fan cable connectors and inspect logic board and fan cable connector pins for damage.  Is there any cable or connector damage on fan or logic board?	Yes	Go to step 14.	\${nodeText.yesSymptomCode}	
		No	Go to step 16.	\${nodeText.noSymptomCode}	



	Check	Result	Action	Code	Commodity
14.	<p>Identify whether fan, logic board, or both are damaged.</p> <p>Are both fan and logic board damaged?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.yesSymptomCode}	
		No	Go to step 15.	\${nodeText.noSymptomCode}	
15.	<p>Identify whether fan or logic board is damaged.</p> <p>Which part is damaged?</p>	Fan	<p>Replace the fan.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC
		Logic Board	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
16.	<p>Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseat fan cable connections to logic board. Reassemble and retest with MRI.</p> <p><b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b></p> <p>Does computer pass fan motor check?</p>	Yes	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	Go to step 17.	\${nodeText.noSymptomCode}	
17.	<p>Troubleshooting this issue completely requires a known-good fan.</p> <p>Do you have immediate access to a known-good fan?</p>	Yes	Go to step 18.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the fan.</p> <p>Verify that the issue is resolved.</p>	X22	OTHER ELECTRIC

	Check	Result	Action	Code	Commodity
18.	Substitute a known-good fan, and retest using MRI.  Does computer now pass fan motor check?	Yes	Replace the fan.  Verify that the issue is resolved.	X22	OTHER ELECTRIC
		No	Reinstall user's fan.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M08	MLB
19.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding.  Remove display panel.  Remove all fan screws and extract fan to reveal heat sink or fan air duct. Use an ESD-safe vacuum to remove dust or debris from inner side of heat sink fin stack. Clean fan rotor blades. Reinstall fan and reseal fan cable connections to logic board. Reassemble and retest with MRI.  <b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b>  Does MRI still report a Txxx thermal sensor test failure?	Yes	Go to step 20.	\${nodeText.yesSymptomCode}	
		No	Issue resolved by cleaning fan and heat sink and reseating fan connections. Verify resolution.	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
20.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the logic board.</p> <p>Refer to service documentation for thermal sensor information and locations.</p> <p>Is a logic board thermal sensor failing a test?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M23	MLB
		No	Go to step 21.	`\${nodeText.noSymptomCode}`	
21.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the Hard Disk Drive (HDD) or Flash Storage.</p> <p><b>Note:</b> Some models do not have a HDD.</p> <p>Is a hard drive or flash storage thermal sensor failing a test?</p>	Yes	Go to step 22.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 26.	`\${nodeText.noSymptomCode}`	
22.	<p>Verify in <a href="#">SM155: Hard Drives Matrix</a> that the installed hard drive or flash storage model is compatible with this computer configuration.</p> <p>Is installed HDD or flash storage compatible with this model?</p>	Yes	Go to step 23.	`\${nodeText.yesSymptomCode}`	
		No	<p>Unsupported HDD or Flash Storage installed, or missing or incorrect hard drive thermal sensor. Check with user for out-of-warranty resolution. Verify resolution.</p>	`\${nodeText.noSymptomCode}`	
23.	<p>Identify the type of storage device affected:</p> <ul style="list-style-type: none"> <li>• Hard Disk Drive (HDD)</li> <li>• Flash Storage</li> </ul> <p>Is the affected device an HDD or flash storage?</p>	HDD	Go to step 24.	`\${nodeText.yesSymptomCode}`	
		Flash Storage	<p>Replace the user's flash storage.</p> <p>Verify that the issue is resolved.</p>	H85	SSD
24.	<p>Troubleshooting this issue completely requires a known-good hard drive data cable or hard drive combo cable (depending on model).</p> <p>Do you have immediate access to a known-good hard drive data cable or hard drive combo cable?</p>	Yes	Go to step 25.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the user's hard drive.</p> <p>Verify that the issue is resolved.</p>	H85	HDD

	Check	Result	Action	Code	Commodity
25.	<p>Substitute a known-good hard drive data cable or hard drive combo cable (depending on model) and retest using MRI.</p> <p>Does computer now pass the THxx sensor check?</p>	Yes	<p>Replace the user's hard drive data cable or hard drive combo cable (depending on model).</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	<p>Reinstall the user's hard drive data cable or combo cable (depending on model). Replace the user's hard drive.</p> <p>Verify that the issue is resolved.</p>	H85	HDD
26.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the power supply.</p> <p>Is a power supply thermal sensor failing a test?</p>	Yes	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P02	POWER SUPPLY
		No	Go to step 27.	\${nodeText.noSymptomCode}	
27.	<p>Identify whether a thermal sensor that is currently failing MRI test is related to the display.</p> <p>Is a display thermal sensor failing a test?</p>	Yes	Go to step 28.	\${nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	M99	
28.	<p>Troubleshooting this issue completely requires a known-good display panel.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 29.	\${nodeText.yesSymptomCode}	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L85	LCD

	Check	Result	Action	Code	Commodity
29.	Substitute a known-good display panel and retest using MRI.  Does MRI still report a TL0p or TL1p thermal sensor test failure?	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	\${nodeText.yesSymptomCode}	
		No	Replace the display panel.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	L85	LCD
30.	Run AST or AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.  Verify that the issue is resolved.  Is the issue resolved?	Yes	Issue resolved.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	M99	

# Kernel Panic or System Instability

## Unlikely causes:

Battery, eDP cable, left speaker, power supply, rear enclosure, right speaker, stand, Wi-Fi/Bluetooth antennas.

## Quick Check

Symptoms	Quick Check
<ol style="list-style-type: none"> <li>1. Computer restarts and displays a kernel panic alert message. Refer to <a href="#">HT200553: If your Mac restarted because of a problem</a>.</li> <li>2. Computer freezes during use.</li> <li>3. Computer freezes upon wake from sleep.</li> <li>4. Computer freezes when Wi-Fi is turned on or activated.</li> </ol> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<p><b>Note:</b> Verify the issue after using the computer for a few minutes to warm it, or by following steps in <a href="#">HT207571: Warm a Mac for testing</a>. Doing this may help identify intermittent issues.</p> <ol style="list-style-type: none"> <li>1. Disconnect any external peripherals and cables to verify the issue. If the kernel panic or system instability no longer occurs with external peripherals and cables disconnected, the issue might be with the peripheral or cable. If so then troubleshoot the peripheral or cable accordingly. You (or the user) may need to contact the peripheral or cable manufacturer for assistance.</li> <li>2. If the issue cannot be easily reproduced (because peripherals or cables are not available, for example), run the Full System Diagnostic suite via AST 2 for extended testing. If no other issues are found, advise the user to only connect external peripherals and cables one at a time. If the issue reoccurs, the user should carefully troubleshoot the last device and cable that was connected to isolate which peripheral or cable causes the issue to reoccur. Also advise the user to check for software and firmware updates from the peripheral or cable manufacturer as appropriate.</li> <li>3. Verify memory configuration matches installed physical memory.</li> <li>4. Hold the Shift key down during startup to put the computer into safe mode. Refer to <a href="#">HT201262: How to use safe mode on your Mac</a>.</li> <li>5. Follow troubleshooting in <a href="#">HT200553: If your Mac restarted because of a problem</a>.</li> <li>6. Reset the SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a> to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.</li> <li>7. Reset the NVRAM using the procedure for this computer in <a href="#">HT204063: Reset NVRAM or PRAM on your Mac</a>.</li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP833: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>

## Deep Dive

	Check	Result	Action	Code	Commodity
1.	<p>A voltage, current, or thermal sensor error can cause kernel panics or system crashes. Run AST 2 Mac Resource Inspector diagnostic suite (MRI) or consult MRI logs to check for any sensor or fan failures.</p> <p>Does MRI report any sensor or fan failures?</p>	Yes	Go to the “Intermittent Shutdown” troubleshooting flow.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 2.	`\${nodeText.noSymptomCode}`	
2.	<p>Start up the computer to macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a>.</p> <p>Use Disk Utility to repair the user’s internal flash storage volume.</p> <p>Attempt to start up the user’s computer from its normal startup volume.</p> <p>Does a kernel panic or crash still occur?</p>	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved after Disk Utility repair. Verify resolution.	`\${nodeText.noSymptomCode}`	
3.	<p>Follow Service Guide procedures to open the computer and remove installed memory. Substitute one by one with a known-good memory module. Refer to <a href="#">HT201191: Install memory in an iMac</a> for instructions.</p> <p>Reset the SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a> to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.</p> <p>Attempt to start up the user’s computer from its normal startup volume.</p> <p><b>Note:</b> The computer performs a memory initialization procedure when you first turn it on after upgrading memory or rearranging DIMMs. This process can take 30 seconds or more, and the display remains dark until the process is finished. Wait until the memory initialization process completes before verifying startup.</p> <p>Does the computer still experience crashes or kernel panics?</p>	Yes	<p>Isolate and replace the defective memory module.</p> <p>Verify that the issue is resolved.</p>	X01	MEMORY
		No	<p>Reinstall the user’s memory.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M06	MLB



	Check	Result	Action	Code	Commodity
4.	Run full system diagnostics via AST 2 and verify that the system is stable with extended use, making sure the computer does not encounter a crash or kernel panic.  Is the issue resolved?	Yes	The issue is resolved. Verify resolution.	\${nodeText.yesSymptomCode}	
		No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	

# No Power

## Unlikely causes:

Camera/microphone/ALS cable, fan, eDP cable, display panel, left speaker, memory, right speaker, flash storage card, stand, Wi-Fi/Bluetooth antennas.

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"> <li>• Computer does not turn on.</li> <li>• Computer does not turn off.</li> <li>• No image on internal or external displays.</li> <li>• No sounds from fan.</li> <li>• No Caps Lock LED when key is pressed on wired keyboard.</li> </ul> <p><b>Note:</b> Inform user that computer failures due to accidental damage are not covered. If applicable, discuss out-of-warranty repair options.</p>	<ol style="list-style-type: none"> <li>1. <b>Important:</b> After logic board replacement, if the computer does not turn on or diagnostic LEDs do not function, this could mean that the replacement logic board has not yet been configured for use. For complete instructions to configure a replacement logic board, refer to <a href="#">TP1657: System Configuration for Macs with the Apple T2 Security Chip</a>. Always complete all applicable procedures and diagnostic suites after part replacement, to ensure that the new part operates properly with the rest of the system.</li> <li>2. Verify that you are using a functional power outlet and a known-good AC power cord.</li> <li>3. Disconnect all peripherals.</li> <li>4. Determine whether the computer has power by confirming that any of the following function correctly: <ul style="list-style-type: none"> <li>• Fan spinning sound</li> <li>• Display backlight on</li> <li>• Any display activity</li> <li>• Caps Lock key light turns on when pressed on wired keyboard</li> </ul> </li> <li>5. Follow suggested steps in <a href="#">HT204267: If your Mac doesn't turn on</a>.</li> <li>6. Check if the computer is in recovery mode. This may happen if a software installation is interrupted. Connect the computer to a host Mac. On the host Mac go to Apple &gt; About this Mac &gt; System Report &gt; USB. If the computer is connected and in recovery mode you should see a message such as "Apple Mobile Device (Recovery)". If the computer is in recovery mode, then the computer's T2 firmware will need to be restored using Apple Configurator. Follow steps in <a href="#">Revive or restore firmware in Apple Configurator 2</a> to revive the T2 firmware on the user's computer before performing further troubleshooting. Restart the computer and verify that it completely starts up to macOS. Refer to <a href="#">HT208862: About the Apple T2 Security Chip</a> for more information.</li> <li>7. Reset the SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.</li> </ol> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP833: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>

	Check	Result	Action	Code	Commodity
1.	The user may report that the computer will not turn off or the computer will not turn on (no power).  Which issue is the user experiencing?	Will Not Turn Off	Go to step 18.	`\${nodeText.yesSymptomCode}`	
		No Power	Go to step 2.	`\${nodeText.noSymptomCode}`	
2.	Connect AC power cord and press power button to start up computer.  Check computer for any signs of power activity, such as fan or Caps Lock LED on wired keyboard.  Does computer show any signs of power activity?	Yes	Go to step 14.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 3.	`\${nodeText.noSymptomCode}`	
3.	Inspect user's power cord for wire or connector damage. Also inspect computer AC inlet for signs of arcing or damaged pins, which could affect power cord connections.  Did you find any damaged components?	Yes	Go to step 4.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 5.	`\${nodeText.noSymptomCode}`	
4.	Determine whether damage affects user's power cord, AC inlet, or both.  Is damage limited to power cord only?	Yes	Replace the user's power cord. Verify that the issue is resolved.	X03	EXTERNAL CABLE
		No	<b>ESCALATION REQUIRED.</b> Contact CSS for additional support or a multipart repair.	`\${nodeText.noSymptomCode}`	
5.	Verify that user's power cord is securely plugged into a known-good, grounded electrical outlet that provides adequate voltage and power to operate computer. Ensure power cord is fully seated to AC inlet. Attempt to turn on computer.  Does issue persist after reseating power cord?	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 14.	`\${nodeText.noSymptomCode}`	
6.	Substitute a known-good power cord and attempt to turn on computer.  Does issue persist with known-good power cord?	Yes	Go to step 7.	`\${nodeText.yesSymptomCode}`	
		No	Replace the user's power cord. Verify that the issue is resolved.	X03	EXTERNAL CABLE

	Check	Result	Action	Code	Commodity
7.	Follow Service Guide procedures to remove the display panel.	Yes	Go to step 8.	`\${nodeText.yesSymptomCode}`	
	<p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Remove the display panel.</p> <p>Disconnect, inspect and reseat:</p> <ul style="list-style-type: none"> <li>• AC inlet power to power supply</li> <li>• DC power cable between power supply and logic board</li> <li>• Power button cable to logic board</li> </ul> <p>Inspect wires and connectors, looking for pinched or exposed wire, and burnt or damaged connectors and pins.</p> <p>Check all power supply bus bars to ensure they are tightly fastened to the logic board. Follow service guide procedures to tighten any loose bus bars.</p> <p>Also inspect the power supply for any damage, such as components that have become loose or broken off.</p> <p>Did you find any damaged components?</p>	No	Go to step 9.	`\${nodeText.noSymptomCode}`	
8.	Determine whether damage affects DC power cable only, or additional components such as power supply or logic board connectors. Multiple damaged parts requiring replacement will be escalated to CSS.	Yes	<p>DC power cable is part of power supply.</p> <p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P16	POWER SUPPLY
	Is damage limited to DC power cable only?	No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
9.	Connect AC power cord and press power button to start up computer.	Yes	Go to step 14.	\$_{nodeText.yesSymptomCode}\$	
	<p>Check computer for any signs of power activity, such as fan or Caps Lock LED on wired keyboard.</p> <p><b>Note:</b> Connecting an external display will permit retesting without reinstalling the internal display panel.</p> <p><b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b></p> <p>Does computer show any signs of power activity?</p>	No	Go to step 10.	\$_{nodeText.noSymptomCode}\$	
10.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding and allow the power supply and logic board to discharge.	Yes	Go to step 11.	\$_{nodeText.yesSymptomCode}\$	
	<p>Remove display panel.</p> <p>Locate diagnostic LEDs on logic board. Connect AC power cord. Press the diagnostic button (near diagnostic LEDs on logic board) to activate and view LEDs. Diagnostic LED #1 should turn on.</p> <p>This indicates that:</p> <ul style="list-style-type: none"> <li>the AC power cord is good</li> <li>the power supply signal cable connection to the logic board is good</li> <li>power supply trickle voltage is good</li> </ul> <p>Is diagnostic LED #1 on?</p>	No	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P01	POWER SUPPLY

	Check	Result	Action	Code	Commodity
11.	<p><b>Important:</b> This step requires multimeter test probes with a very fine point in order to reach the conductive portion of the power button connector. Do not request a replacement enclosure unless you are using the correct multimeter probes when testing the power button.</p> <p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding and allow the power supply and logic board to discharge.</p> <p>Disconnect power button cable from logic board to inspect cable and connector for damage. Using a multimeter set as ohm meter, verify continuity between the two pins of the power button when it is pressed.</p>	Yes	Go to step 12.	#{nodeText.yesSymptomCode}	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Replace the rear enclosure which includes the power button and cable. Verify that the issue is resolved.</p> <p>Rear cover replacement is not normally covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>If the power button issue was not caused by accidental damage, then contact CSS for additional support regarding warranty coverage for this part.</p>	X14	
	<p>A properly working power button should be open (disconnected) when the button is released and closed (connected) when the button is pressed.</p> <p>A meter reading of 0 to 0.2 <math>\Omega</math> (ohms) means that the power button has continuity (the button is closed or connected).</p> <p>A meter reading of 0.2 <math>\Omega</math> (ohms) to <math>\infty</math> (infinity) means that the power button does not have continuity (the button is open or disconnected).</p> <p>For additional information on using a multimeter, see <a href="#">HT3250: Using a digital multimeter</a>.</p> <p>Does power button have continuity when button is pressed and open when released?</p>				

	Check	Result	Action	Code	Commodity
12.	Reconnect power button cable to logic board.	Yes	Go to step 13.	\$_{nodeText.yesSymptomCode}\$	
	<p>Connect AC power cord and press power button to start up computer.</p> <p>Press the diagnostic button (near diagnostic LEDs on logic board) to activate and view LEDs. Diagnostic LEDs #1 and #2 should turn on. This indicates power to computer.</p> <p><b>Important:</b> Only diagnostic LED #1 will turn on if the logic board was replaced and not serialized using the steps provided in <a href="#">TP1657: System Configuration for Mac Computers with the Apple T2 Security Chip</a>.</p> <p>Are both diagnostic LED #1 and LED #2 on?</p>	No	<p>Replace the power supply.</p> <p>Verify that the issue is resolved.</p>	P01	POWER SUPPLY
13.	Check computer for any signs of power activity, such as fan or Caps Lock LED on wired keyboard.	Yes	Go to step 14.	\$_{nodeText.yesSymptomCode}\$	
	Does computer show any signs of power activity?	No	Go to step 15.	\$_{nodeText.noSymptomCode}\$	
14.	<p>Verify whether a video signal appears on display.</p> <p>Is a video image clearly visible on display?</p>	Yes	<p>Run Mac Resource Inspector (MRI) to obtain latest test results.</p> <p>Verify that the issue is resolved</p>	\$_{nodeText.yesSymptomCode}\$	
		No	<p>Shine a bright light on the display to illuminate it.</p> <p>The Apple menu icon in the menu bar should always be visible and provide a reliable, high-contrast, and identifiable icon.</p> <p>If the display shows a legible image despite not being backlit, then return to the list of symptoms and select “Backlight Issues or No Backlight” from the troubleshooting menu.</p> <p>If the display is blank and backlit, then return to the list of symptoms and select “Power But No Video” from the troubleshooting menu.</p>	\$_{nodeText.noSymptomCode}\$	



	Check	Result	Action	Code	Commodity
15.	Troubleshooting this issue completely requires a known-good power supply.	Yes	Go to step 16.	`\${nodeText.yesSymptomCode}`	
	Do you have immediate access to a known-good power supply?	No	Go to step 17.	`\${nodeText.noSymptomCode}`	
16.	<b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur.	Yes	Replace the power supply. Verify that the issue is resolved.	P01	POWER SUPPLY
	Substitute a known-good power supply and attempt to turn on computer.  Does computer show any signs of power activity?	No	Go to step 17.	`\${nodeText.noSymptomCode}`	
17.	<b>Important:</b> Remove AC power to computer and wait two minutes.  Measure the logic board coin battery voltage.  Refer to the Service Guide for information about locating the RTC battery measurement test pads.  Carefully touch one multimeter probe to each pad to measure an expected coin battery voltage of 3 volts DC. If the voltage is 2.7 VDC or less, replace the coin battery.	Yes	Replace coin cell battery.  <b>Note:</b> Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). The coin battery is no longer available to order via GSX. Please order this battery from an electronics parts distributor.  <b>Note:</b> BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life.  Verify that the issue is resolved.	X32	OTHER ELECTRIC
	For additional information on using a multimeter, see <a href="#">HT3250: Using a digital multimeter</a> .  Is the coin battery voltage low (2.7 VDC or less)?	No	Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M01	MLB
18.	If any app hangs or freezes when the computer is shutting down, then try to force quit that app. Also check if any software updates are in progress.	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Does the computer turn off?	No	Go to step 19.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
19.	Press and hold down the power button for 10 seconds or until user's computer powers off.  Does the computer turn off?	Yes	Go to step 20.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 21.	`\${nodeText.noSymptomCode}`	
20.	Reset SMC using the procedure listed for this computer in <a href="#">HT201295: How to reset the SMC of your Mac</a> . Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.  Does issue persist after SMC reset?	Yes	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	`\${nodeText.yesSymptomCode}`	
		No	Issue resolved after SMC reset. Verify resolution.	`\${nodeText.noSymptomCode}`	
21.	Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding and allow the power supply and logic board to discharge.  Remove display panel.  Disconnect, inspect and reseat: <ul style="list-style-type: none"> <li>• AC inlet power to power supply</li> <li>• DC power cable between power supply and logic board</li> <li>• Power button cable to logic board</li> </ul> Inspect wires and connectors, looking for pinched or exposed wire, and burnt or damaged connectors and pins.  Check all power supply bus bars to ensure they are tightly fastened to the logic board. Follow service guide procedures to tighten any loose bus bars.  Also inspect the power supply for any damage, such as components that have become loose or broken off.  Did you find any damaged components?	Yes	Go to step 22.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 23.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
22.	<p>Determine whether damage affects power button cable only from main logic board to rear enclosure, or additional components such as power supply or logic board connectors. Multiple damaged parts requiring replacement will be escalated to CSS.</p> <p>Is damage limited to power button cable only?</p>	Yes	<p><b>ESCALATION REQUIRED.</b></p> <p>Replace the rear enclosure which includes the power button and cable. Verify that the issue is resolved.</p> <p>Rear cover replacement is not normally covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>If the power button issue was not caused by accidental damage, then contact CSS for additional support regarding warranty coverage for this part.</p>	X14	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	\${nodeText.noSymptomCode}	

	Check	Result	Action	Code	Commodity
23.	<p><b>Note:</b> This step requires multimeter test probes with a very fine point in order to reach the conductive portion of the power button connector. Do not request a replacement enclosure unless you are using the correct multimeter probes when testing the power button.</p> <p>Turn off computer. Unplug computer from AC mains by disconnecting both ends of its power cord. Ensure computer is completely disconnected from AC mains before proceeding and allow the power supply and logic board to discharge.</p> <p>Disconnect power button cable from logic board to inspect cable and connector for damage. Using a multimeter set as ohm meter, verify continuity between the two pins of the power button when it is pressed.</p> <p>A properly working power button should be open (disconnected) when the button is released and closed (connected) when the button is pressed.</p> <p>A meter reading of 0 to 0.2 <math>\Omega</math> (ohms) means that the power button has continuity (the button is closed or connected).</p> <p>A meter reading of 0.2 <math>\Omega</math> (ohms) to <math>\infty</math> (infinity) means that the power button does not have continuity (the button is open or disconnected).</p> <p>For additional information on using a multimeter, see <a href="#">HT3250: Using a digital multimeter</a>.</p> <p>Does power button have continuity when button is pressed and open when released?</p>	Yes	<p>No failure found during diagnostic testing. Using correct positioning, return computer to user with no trouble found.</p> <p>Verify that the issue is resolved.</p>	<code>\${nodeText.yesSymptomCode}</code>	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Replace the rear enclosure which includes the power button and cable. Verify that the issue is resolved.</p> <p>Rear cover replacement is not normally covered by Apple's one-year limited warranty or the AppleCare Protection Plan. Refer to <a href="http://www.apple.com/legal/warranty">www.apple.com/legal/warranty</a>.</p> <p>If the power button issue was not caused by accidental damage, then contact CSS for additional support regarding warranty coverage for this part.</p>	X14	

	Check	Result	Action	Code	Commodity
24.	Verify that the computer can now turn on using the power button, over multiple trials.	Yes	The issue is resolved.	\${nodeText.yesSymptomCode}	
	Run AST 2 Full System diagnostic suites (EFI & OS), if available, to ensure no other issues remain.  Is the issue resolved?	No	<b>ESCALATION REQUIRED.</b>  Contact CSS for additional support or a multipart repair.	X99	

# Will Not Start Up

## Unlikely causes:

Camera/front microphone/ALS cable, fan, DisplayPort cable, left speaker, power supply, rear enclosure, right speaker, stand

## Quick Check

Symptoms	Quick Check
<ul style="list-style-type: none"><li>• Computer turns on but does not complete startup sequence.</li><li>• Some video activity is seen, such as Apple logo, progress bar.</li><li>• Prohibitory sign or folder with flashing question mark is seen.</li><li>• Audible fan sounds are heard.</li><li>• Caps Lock LED on wired keyboard toggles on and off when pressed.</li></ul>	<ol style="list-style-type: none"><li>1. <b>Important:</b> After logic board replacement, if the computer does not turn on or diagnostic LEDs do not function, this could mean that the replacement logic board has not yet been configured for use. For complete instructions to configure a replacement logic board, refer to <a href="#">TP1657: System Configuration for Macs with the Apple T2 Security Chip</a>. Always complete all applicable procedures and diagnostic suites after part replacement, to ensure that the new part operates properly with the rest of the system.</li><li>2. Verify that you are using a functional power outlet and a known-good AC power cord.</li><li>3. Remove all external devices, except for a known-good USB keyboard and mouse, to help rule out peripherals as a possible cause of this issue.</li><li>4. Determine whether the computer has power by confirming that any of the following function correctly:<ul style="list-style-type: none"><li>• Fan spinning sound.</li><li>• Display backlight on.</li><li>• Any display activity.</li><li>• Caps Lock key light turns on when pressed on wired keyboard.</li></ul><p>If the computer shows no signs of power, then return to the list of symptoms and select “No Power” from the troubleshooting menu.</p><p>If the computer starts up but does not display an image, then return to the list of symptoms and select “Power But No Video” from the troubleshooting menu.</p><p>If the computer starts up to a kernel panic, then return to the list of symptoms and select “Kernel Panic or System Instability” from the troubleshooting menu.</p></li><li>5. Try to determine what the computer was doing during startup. Refer to <a href="#">HT204156: If your Mac doesn't start up all the way</a>.</li><li>6. Follow suggested steps in <a href="#">HT204267: If your Mac doesn't turn on</a> and <a href="#">HT204463: If the fans in your Mac run at full speed when you turn it on</a>.</li><li>7. Hold down the Shift key during startup to put the computer into safe mode. Refer to <a href="#">HT201262: How to use safe mode on your Mac</a>.</li><li>8. Check if the computer is in recovery mode. This may happen if a software installation is interrupted. Connect the computer to a host Mac. On the host Mac go to Apple &gt; About this Mac &gt; System Report &gt; USB. If the computer is connected and in recovery mode you should see a message such as “Apple Mobile Device (Recovery)”. If the computer is in recovery mode, then the computer's T2 firmware will need to be restored using Apple Configurator. Follow steps in <a href="#">Revive or restore Mac firmware in Apple Configurator 2</a> to revive the T2 firmware on the user's computer before performing further troubleshooting. Restart the computer and verify that it completely starts up to macOS. Refer to <a href="#">HT208862: About the Apple T2 Security Chip</a> for more information.</li><li>9. Reset the SMC using the procedure listed for this</li></ol>

	<p>computer in <a href="#">HT201295: How to reset the SMC of your Mac</a>. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.</p> <p><b>Warning:</b> Be extremely careful when working inside the computer with power applied and the system energized. Avoid touching the logic board or power supply while the computer is plugged in. Always cover the power supply and logic board with power supply covers to protect yourself when working inside the computer.</p> <p>Before removing any components, turn off the computer and unplug it from AC mains by disconnecting both ends of the power cord. Ensure the computer is completely disconnected from AC mains before proceeding.</p> <p>For additional safety information and tips, refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP833: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP820: iMac (27-inch): Safety</a></li> </ul> <p>For iMac Pro (2017), refer to:</p> <ul style="list-style-type: none"> <li>• <a href="#">TP1620: Power Supply Cover Instructions</a></li> <li>• <a href="#">TP1637: Safety</a></li> </ul>
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## Deep Dive

	Check	Result	Action	Code	Commodity
1.	Verify that the computer completes the full startup process: Apple logo > progress indicator > login screen > user's desktop.	Yes	Issue cannot be duplicated.	`\${nodeText.yesSymptomCode}`	
	Does the computer complete the startup process to the user's desktop?	No	Go to step 2.	`\${nodeText.noSymptomCode}`	
2.	Start up the computer to macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	Go to step 3.	`\${nodeText.yesSymptomCode}`	
	Does computer start up from recovery partition?	No	Go to step 4.	`\${nodeText.noSymptomCode}`	
3.	Start up the computer to macOS Recovery. See <a href="#">HT201314: About macOS Recovery</a> .	Yes	Issue resolved after Disk Utility repair. Verify resolution.	`\${nodeText.yesSymptomCode}`	
	Use Disk Utility to repair the user's internal flash storage volume.	No	Reinstall macOS on the user's computer.	`\${nodeText.noSymptomCode}`	
	Attempt to start up the user's computer from its normal startup volume.		Check for and apply the latest software and firmware updates.		
	Does computer complete startup process to user's desktop?		Verify that the issue is resolved.		

	Check	Result	Action	Code	Commodity
4.	Follow Service Guide procedures to remove the display panel to view the diagnostic LEDs on the logic board.	Yes	Go to step 6.	`\${nodeText.yesSymptomCode}`	
	<p>After unplugging the computer from the electrical outlet, wait two minutes before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.</p> <p>Use the iMac Display Extension Cable Kit and the iMac LCD Service Support Stand to connect the display outside of the computer so you can see the startup process.</p> <p>Refer to <a href="#">TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit</a> for information about how to use extension cables.</p> <p><b>Warning: HIGH VOLTAGE: The power supply remains energized whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed.</b></p> <p>Connect AC power cord and press the power button to start up the computer.</p> <p>Refer to the Service Guide to locate and view the memory diagnostic LED. The memory LED should illuminate, indicating that memory is functioning.</p> <p>Is the memory diagnostic LED illuminated?</p>	No	Go to step 5.	`\${nodeText.noSymptomCode}`	



	Check	Result	Action	Code	Commodity
5.	Follow Service Guide procedures to open the computer and remove installed memory. Substitute one by one with a known-good memory module. Refer to HT201191: Install memory in an iMac for instructions.	Yes	Isolate and replace the defective memory module.  Verify that the issue is resolved.	X02	MEMORY
	Reset the SMC using the procedure listed for this computer in HT201295: How to reset the SMC of your Mac to return computer to a known power-off state. Try to turn on from power-off state. Do not hold in the power button when turning on the computer. You could inadvertently put the computer into DFU mode if you do.	No	Reinstall the user's memory.  Replace the logic board.  Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.  Verify that the issue is resolved.	M02	MLB
	Attempt to start up the user's computer from its normal startup volume.  Check for any signs that the computer is starting up.  <b>Note:</b> The computer performs a memory initialization procedure when you first turn it on after upgrading memory or rearranging DIMMs. This process can take 30 seconds or more, and the display remains dark until the process is finished. Wait until the memory initialization process completes before verifying startup.  Can you confirm that the computer is starting up?				
6.	Continue viewing all diagnostic LEDs during computer startup.	Yes	Go to step 12.	`\${nodeText.yesSymptomCode}`	
	All LEDs should illuminate within a few seconds, indicating that power supply, memory, GPU, eDP link, and display TCON connections are all functioning properly.  Refer to the Service Guide for specific diagnostic LED indications and definitions.  Are all remaining diagnostic LEDs illuminated?	No	Go to step 7.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
7.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Remove display panel and inspect eDP cable for misrouting. Disconnect eDP cable from logic board. Inspect cable for pinching and cable connector for damaged or bent pins.</p> <p>Is the cable or its connector damaged?</p>	Yes	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 8.	`\${nodeText.noSymptomCode}`	
8.	<p>Keep eDP cable disconnected from logic board. Inspect eDP connector on the logic board for damaged or bent pins.</p> <p>Is logic board cable connector damaged?</p>	Yes	<p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M24	MLB
		No	Go to step 9.	`\${nodeText.noSymptomCode}`	
9.	<p>Reseat the eDP cable between display panel and logic board.</p> <p><b>Warning:</b> Be extremely careful when working inside the computer when power is applied and system is energized. Avoid touching the logic board or power supply while the computer is plugged in.</p> <p>Is normal video restored?</p>	Yes	Issue resolved by reseating embedded DisplayPort (eDP) cable. Verify issue resolution.	`\${nodeText.yesSymptomCode}`	
		No	Go to step 10.	`\${nodeText.noSymptomCode}`	

	Check	Result	Action	Code	Commodity
10.	<p>Troubleshooting this issue completely requires a known-good eDP cable.</p> <p>The iMac Display Extension Cable Kit contains an eDP substitution cable that can be used for testing.</p> <p>Refer to <a href="#">TP981: iMac (27-inch): Testing the Panel Using the Display Extension Cable Kit</a> or <a href="#">TP982: iMac (21.5-inch): Testing the Panel Using the Display Extension Cable Kit</a> for information about how to use extension cables.</p> <p>Do you have immediate access to a known-good eDP cable?</p>	Yes	Go to step 11.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
11.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove the power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good eDP cable or use the eDP substitution cable found in the extension cable kit in place of suspect eDP cable.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the embedded DisplayPort (eDP) cable.</p> <p>Verify that the issue is resolved.</p>	X03	INTERNAL CABLE
		No	Go to step 12.	`\${nodeText.noSymptomCode}`	
12.	<p>To troubleshoot this issue completely, a known-good display panel is required.</p> <p>Do you have immediate access to a known-good display panel?</p>	Yes	Go to step 13.	`\${nodeText.yesSymptomCode}`	
		No	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L03	LCD

	Check	Result	Action	Code	Commodity
13.	<p><b>Important:</b> Ensure that user's computer is shut down, then remove power cord and wait two minutes for self discharge to occur. Remember to remove power cord whenever disconnecting modules or substituting cables and components.</p> <p>Substitute a known-good display panel.</p> <p>Is normal video restored?</p>	Yes	<p>Replace the display panel.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	L03	LCD
		No	<p>Reinstall the user's display panel.</p> <p>Replace the logic board.</p> <p>Refer to the Service Guide to complete all applicable procedures and diagnostic suites after part replacement to ensure that the new part operates properly with the rest of the system.</p> <p>Verify that the issue is resolved.</p>	M02	MLB
14.	<p>Verify that the computer can now complete the startup process over multiple trials.</p> <p>Run AST 2 Full System diagnostic suites (EFI &amp; OS), if available, to ensure no other issues remain.</p> <p>Is the issue resolved?</p>	Yes	The issue is resolved.	`\${nodeText.yesSymptomCode}`	
		No	<p><b>ESCALATION REQUIRED.</b></p> <p>Contact CSS for additional support or a multipart repair.</p>	X99	

# iMac (27-inch) Safety



**Warning! Electrical Shock Hazard:** Use extreme caution when troubleshooting with the display panel removed. Avoid touching the logic board or power supply while the computer is plugged in, the power supply retains a charge whether or not the computer is on.

After unplugging the computer from the electrical outlet, **wait two minutes** before removing the display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.

- Never remove or install any physical components while the computer is plugged in to an electrical outlet.
- When plugged in, the power supply and logic board are energized, even when the computer is turned off.
- Unplug the computer and wait two minutes for the power supply and logic board to self-discharge before removing the display panel.
- Do NOT touch the logic board or power supply while the computer is plugged in, or before the two minute wait time has passed to discharge stored voltage to a safe level after being unplugged.

Refer to article [TP833: iMac and Displays: Power Supply Cover Instructions](#) for additional information on installing the protective covers. The power supply cover provides protection against unintended contact with the energized power supply, which may result in injury from electric shock. ALWAYS use the protective power supply cover during service when the glass panel and LCD have been removed from the iMac, LED Cinema Display, and Thunderbolt Display.

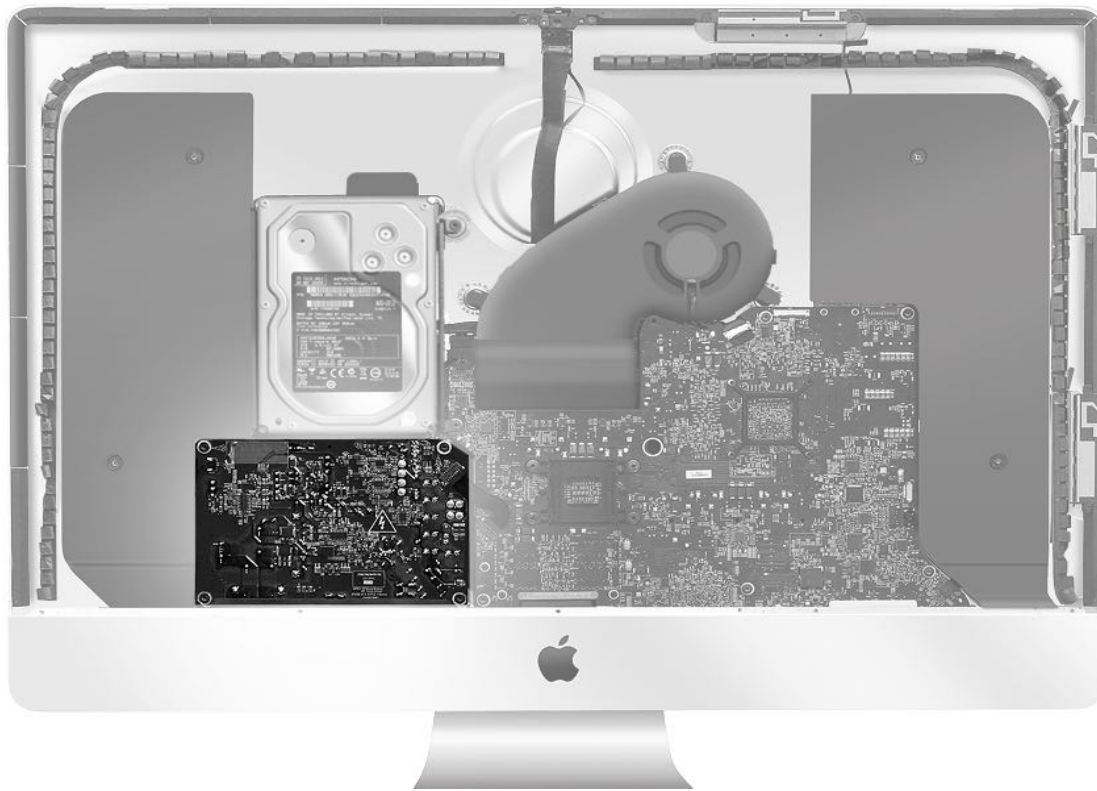
**Warning:** iMac models require two protective covers (923-0189) when performing live adjustments; one for the power supply and one for the backlight control circuitry on the logic board. Secure the covers to the rear housing with tape, as shown in the last image below.

## Electrical Safety Precautions

Before working on a computer with exposed, potentially energized parts:

- Remove rings, watches, necklaces, metal-rimmed eyewear, and other metallic articles which increase your risk of electric shock.
- Do not wear a cell phone or other signaling device, as these may cause a dangerous startle reflex during energized work.
- **If the iMac needs to be plugged in for LED checks or similar troubleshooting, do NOT wear an ESD wrist strap.** Wearing an ESD grounding system increases your risk of electric shock in this situation.
- Remain alert, focused on the work being performed, and aware of the proximity of grounded objects to your body.
- Use a black stick or other non-metal extension tool as needed to connect or disconnect cables, to keep fingers away from potentially energized parts.

**Power supply location:**



**Logic board location:**



**Protective power supply cover placement**



**Warning:** Use the protective power supply covers when the computer is plugged in or when performing live adjustments. On

these models, place a cover over both the power supply and the logic board when doing live adjustments. Secure the covers to the rear housing with tape, as shown below. Avoid touching the logic board or power supply while the computer is plugged in and the display panel is removed.

Refer to articles:

- [TP833: Power Supply Cover Instructions](#)
- [TP981: Testing the Panel Using the Display Extension Cable Kit](#)





# Power Supply Cover Instructions



**WARNING: HIGH VOLTAGE:** The power supply remains powered up whenever the computer is plugged in, whether or not the computer has been turned on. Use extreme caution when troubleshooting with the display panel removed. Avoid touching the logic board or power supply while the computer is plugged in.

- Never remove or install any physical components while the computer is plugged in to an electrical outlet.
- When plugged in, the power supply and logic board are energized, even when the computer is powered off.
- Unplug computer and allow sufficient time for the power supply and logic board to self-discharge before removing display panel.
- Do NOT touch the logic board or power supply while the computer is plugged in, or before sufficient time has passed to discharge stored voltage to a safe level after being unplugged.

## Discharge wait time:

### iMac models Late 2011 and earlier, LED Cinema Display, and Thunderbolt Display:

- Wait one hour after unplugging the computer from the electrical outlet before removing the power supply or working near the power supply leads.

### iMac models Late 2012 and later:

- Wait two minutes after unplugging the computer from the electrical outlet before removing display panel, disconnecting modules, or substituting cables and components. This will allow the power supply and logic board time to discharge.

## Electrical Safety Precautions:

Before working on a computer with exposed, potentially energized parts:

- Remove rings, watches, necklaces, metal-rimmed eyewear, and other metallic articles which increase your risk of electric shock.
- Do not wear a cell phone or other signaling device, as these may cause a dangerous startle reflex during energized work.
- **If the iMac needs to be plugged in for LED checks or similar troubleshooting, do NOT wear an ESD wrist strap.** Wearing ESD grounding systems increases your risk of electric shock.
- Remain alert, focused on the work being performed, and aware of the proximity of grounded objects to your body.
- Use the plastic black stick or other non-metal extension tool as needed to connect or disconnect cables, to keep fingers away from potentially energized parts.

## Tools Required

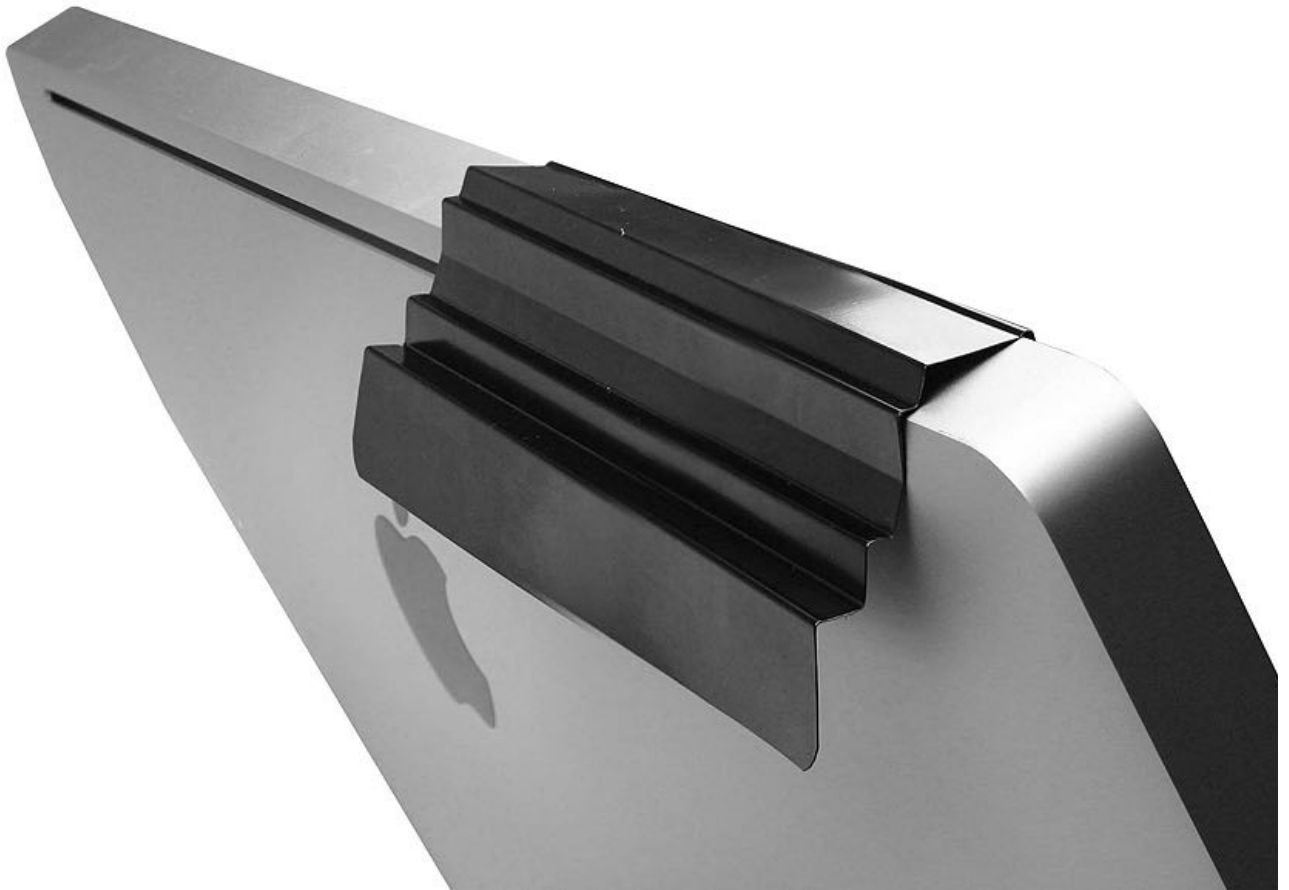
- A ruler
  - Kapton tape or painter's tape
  - Power supply protective cover, 923-0189, pkg. of 2
1. Before using the power supply cover for the first time, position the cover with the part number face-down, then fold the cover once to create a 90-degree bend. The fold location is marked by a linear indentation (see dotted line in image) in the cover. Use a ruler as a guide to make the fold.

**Note:** The iMac (Late 2012 and later) models require two protective covers when performing live adjustments; one for the power supply and one for the backlight control circuitry on the logic board. Secure the covers to the rear housing with tape, as shown in step 5.



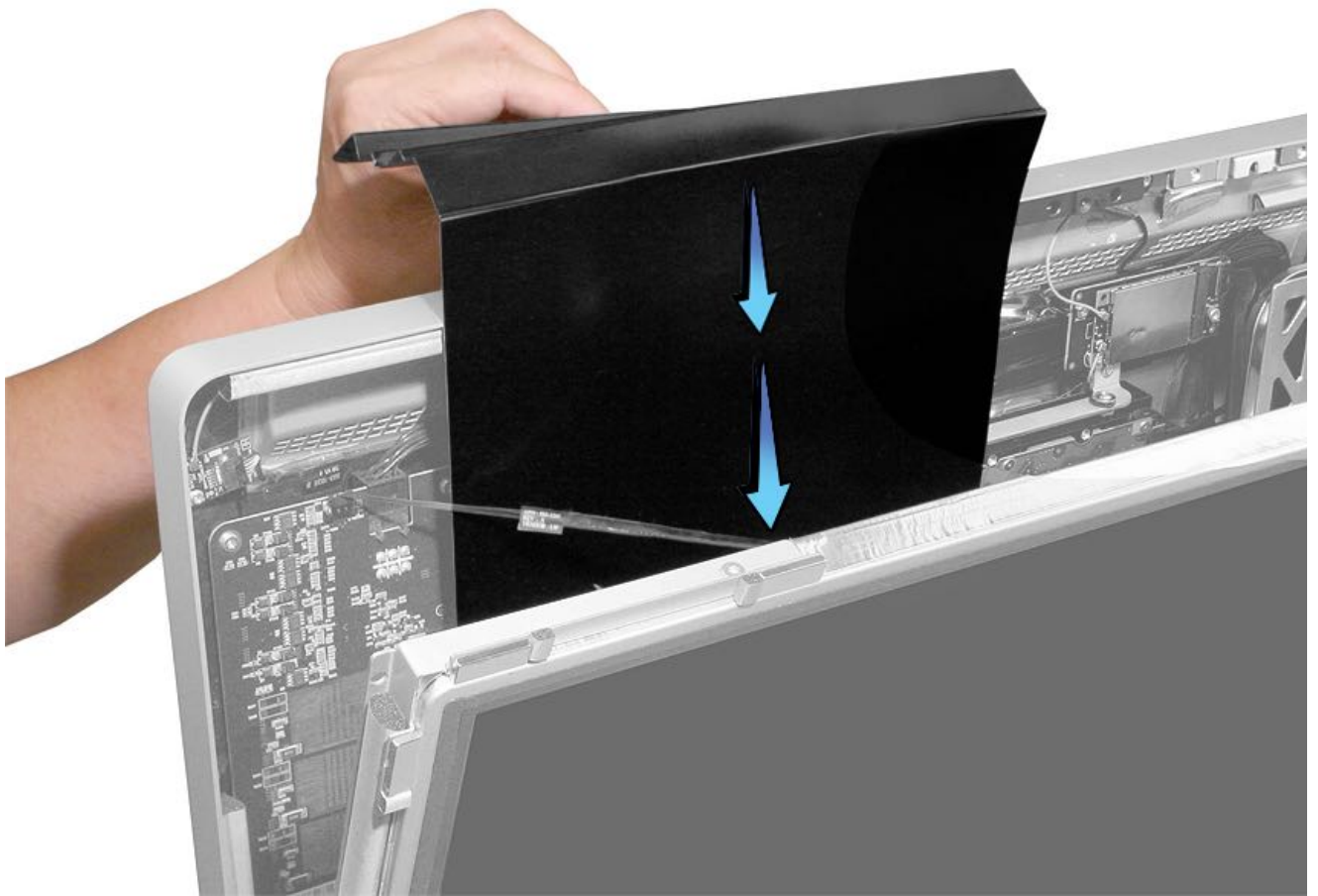


2. The pre-formed bends allow the cover to fit the rear housing on a variety of iMacs and displays (as shown).

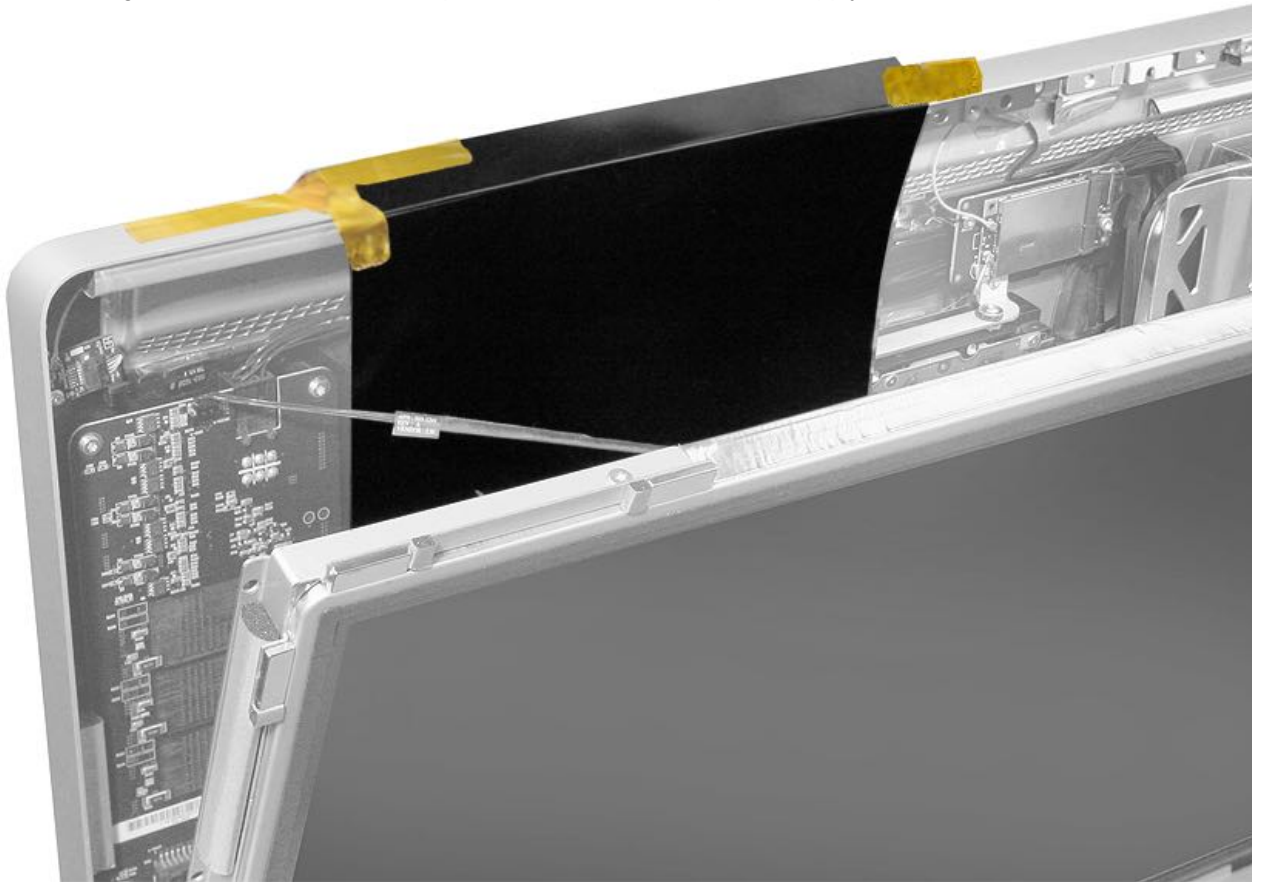


3. On older iMac models, before removing the LCD, tilt the panel open three inches and carefully slide the power supply cover into place. Hang the cover over the rear housing, covering the power supply.

**Note:** The iMac (Late 2012 and later) models require two protective covers when performing live adjustments; one for the power supply and one for the backlight control circuitry on the logic board. Secure the covers to the rear housing with tape, as shown in step 5.



4. Secure the power supply cover with Kapton or painter's tape along the top edge of the rear housing to prevent the shield from sliding. **Note:** Refer to the model-specific Service Guide for power supply cover instructions.

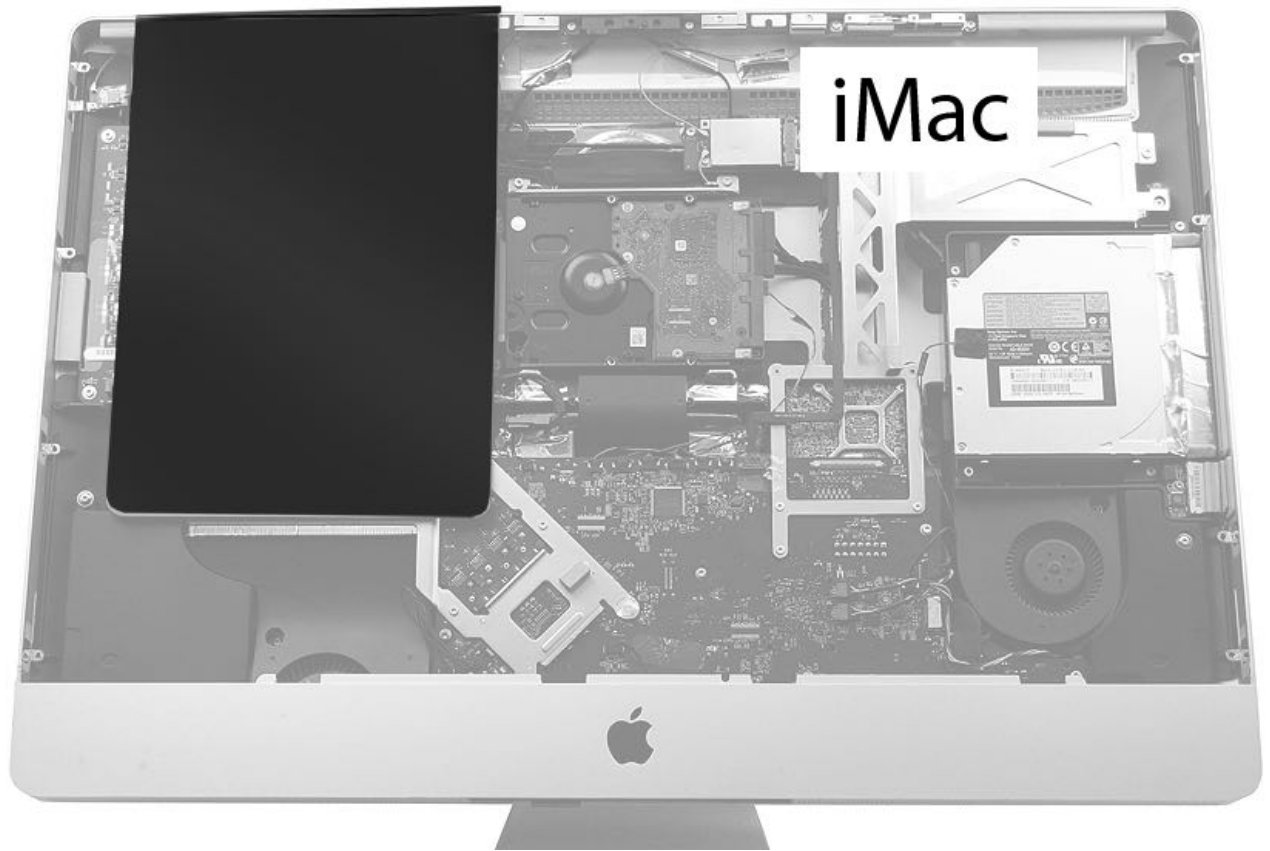


**WARNING:** Due to the immediate proximity of the power supply in some iMac models, do not use fingertips to

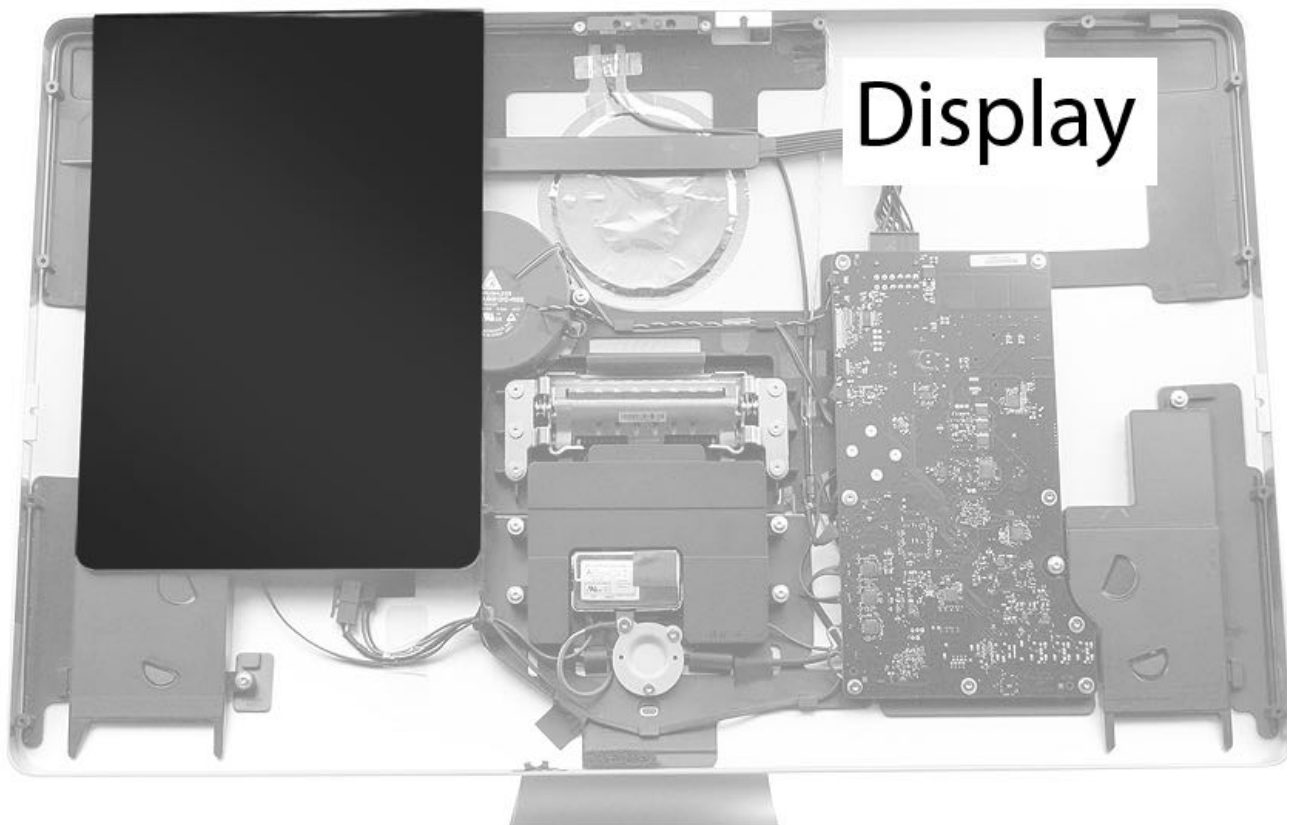
disconnect the LCD backlight controller cable. Use a black stick as directed in model-specific Apple Service Guide instructions to keep your fingertips away from the electrical hazard.

5. Make sure the energized modules are completely covered. On older models, the power supply should be covered as completely as possible before reaching into the system to disconnect display cables, remove modules, or perform live testing. On iMac models (Late 2012 and later), cover both the power supply and logic board. Refer to the last two images in this step for their cover placement.

**iMac models (Late 2011 and earlier) protective power supply cover placement**



**LED Cinema Display and Thunderbolt Display protective power supply cover placement**



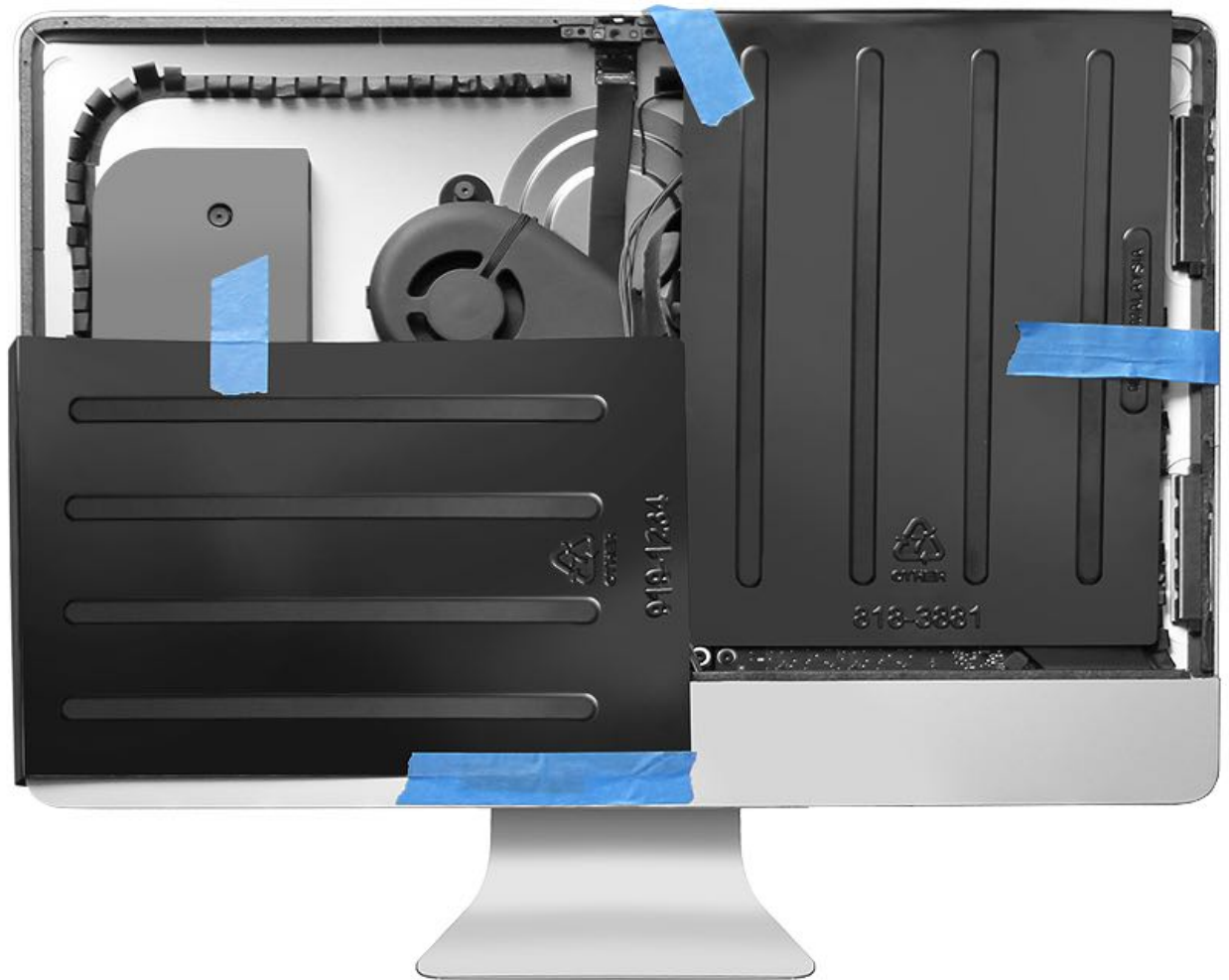
### iMac (27-inch, Late 2012 and later) protective power supply cover placement

**Warning:** On these models, place a cover over both the power supply and logic board when doing live adjustments. Avoid touching the logic board or power supply while the computer is plugged in.



### iMac (21.5-inch, Late 2012 and later) protective power supply cover placement

**Warning:** On these models, place a cover over both the power supply and logic board when doing live adjustments. Avoid touching the logic board or power supply while the computer is plugged in.



6. The power supply protective cover may be reused. However, before reusing, visually inspect shield for:
  - Holes, tears, punctures, or cuts.
  - Textural defects such as swelling, softening, hardening, or stickiness.
  - Other defects that degrade insulating quality.
7. If any wear or other defects are found, discard the shield, and use a new cover (part number 923-0189).



# Cleaning and Handling a Broken Display Panel

## Cleaning and Handling a Broken Display Panel for iMac (Late 2012 and later) and iMac Pro (2017)

### Tools for Cleaning

- Safety glasses
- iMac service wedge (included with the display panel starter kit, 076-1444)
- Clean, damp cloth (to clean display panel glass)
- Isopropyl alcohol (IPA) wipes (to remove residual VHB adhesive)
- iMac (Retina 5K, 27-inch, 2020) can be configured with a nano-texture glass display. Additional tools are required:
  - Apple polishing cloth for nano-texture glass (923-04724)
  - Gloves, anti-static and lint-free (922-8253)

### Cleaning the Display

**Caution:** The unique surface of the nano-texture glass [requires special care when cleaning](#) (HT210229). Follow the special care instructions and use only the Apple polishing cloth (923-04724) to clean the nano-texture glass display. Wear anti-static and lint-free gloves to avoid leaving fingerprints.

For displays with standard glass:

1. Clean the front of the display with a clean, damp, lint-free cloth.  
**Caution:** Do not use IPA wipes to clean the display. IPA wipes should only be used to remove residual VHB adhesive.
2. Polish the display panel with an anti-static, microfiber, optical-grade polishing cloth (922-8263, package of five).



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### Glass Safety Precautions

All models have a glass display panel that attaches to the front of the computer, which must be removed to access internal components.



### **If the display panel glass breaks and a glass shard enters the eye:**

- Seek medical attention immediately!
- Do not rub your eye if you feel you have something in your eye.
- Do not use an eye wash. An eye wash can push or move the shard of glass and cause more damage.
- Keep the eye closed or loosely patch the eye to keep the eye from moving.

### **Handling a Broken Display Panel**

- The display panel glass is not tempered and will break into sharp pieces if mishandled. Removing the display panel requires special tools.
- Safety glasses are recommended when removing the display panel.



### **Tools**

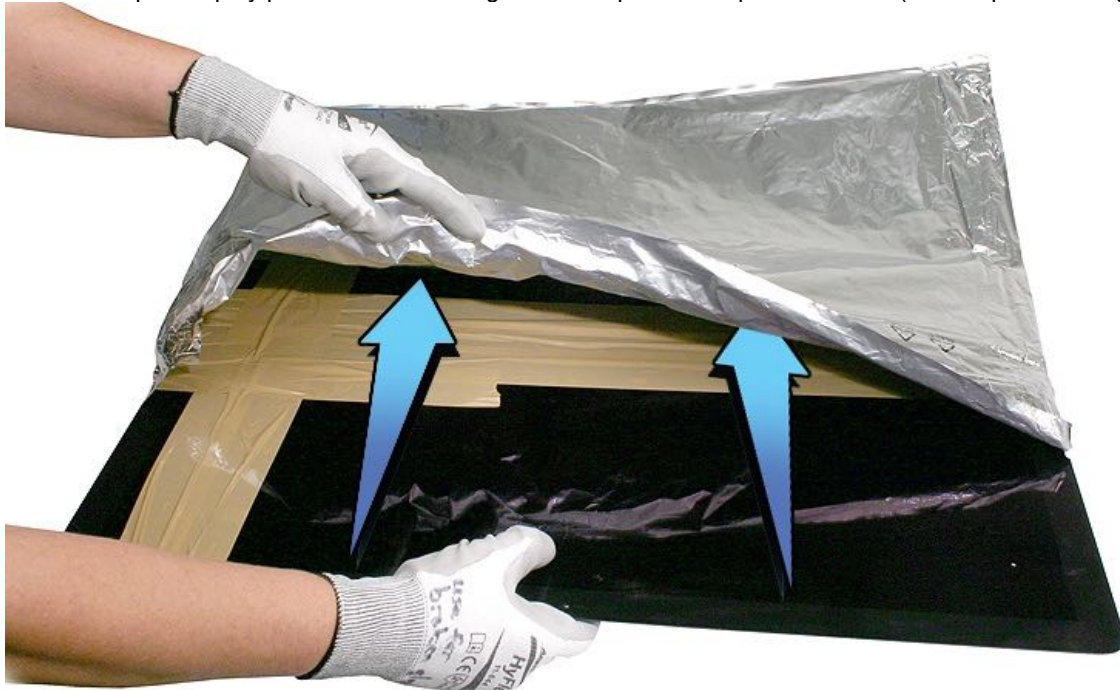
- Display panel starter kit (Refer to [TP818: Required Tools](#) for part numbers.)
- Material handling gloves (such as leather or cut-resistant gloves)
- Packing tape or equivalent
- Safety glasses
- Large ESD bags (922-8258) - 24x20-inch bags that accommodate a 21.5-inch display, package of five
- Large ESD bags (922-9468) - 24x30-inch bags that accommodate a 27-inch display, package of five
- Large box

### **Handling a Broken Display Panel**

1. Put on safety glasses and material handling gloves.
2. If the display panel is broken and is still attached to the rear housing, then secure the broken glass with packing tape and carefully follow the Display Panel Removal procedure.
3. Lay the display panel on a smooth, clean work surface.
4. Apply tape, thoroughly covering the broken display panel.

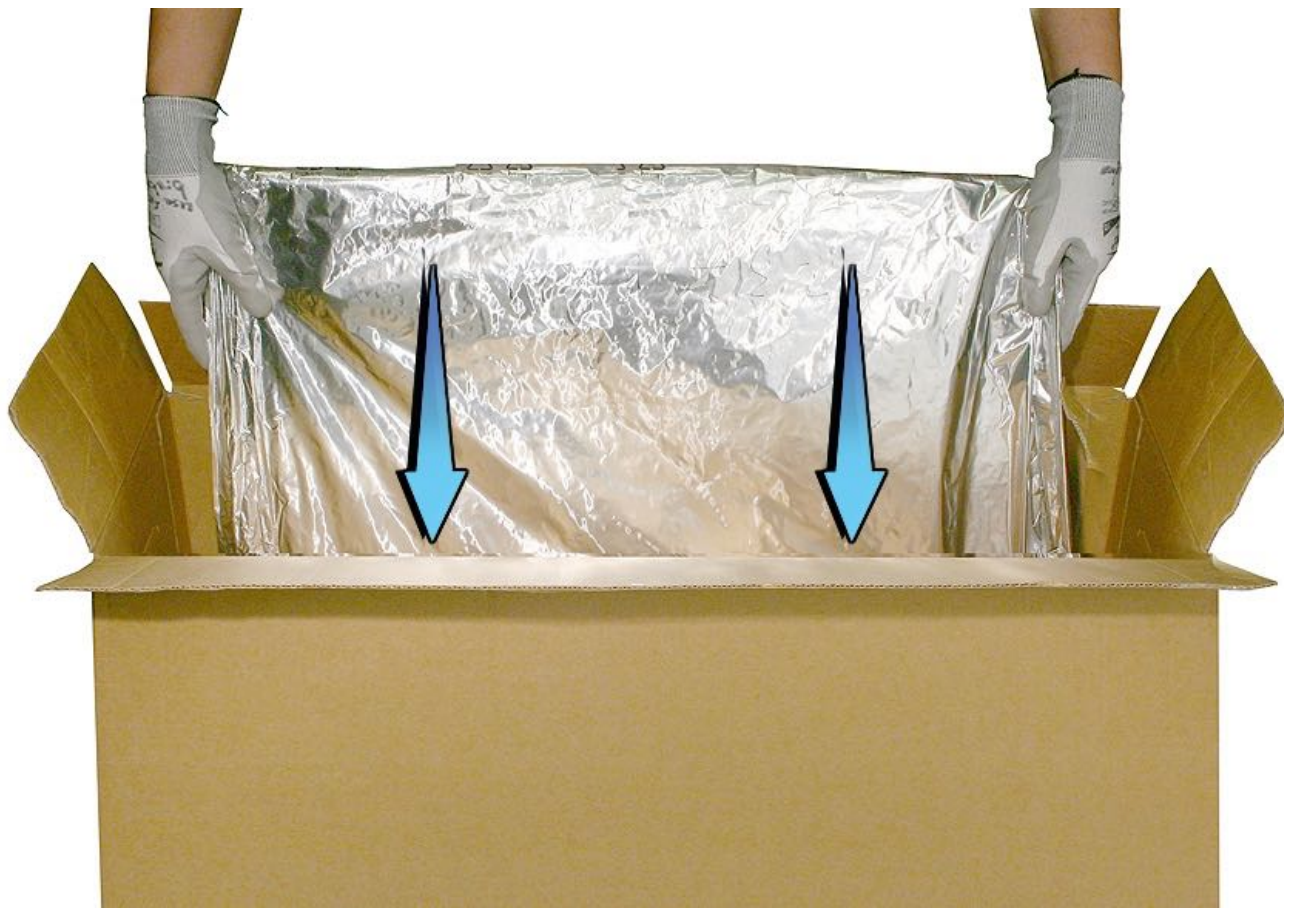


5. Place the taped display panel in the ESD bag that the replacement panel came in (or an equivalent large bag).



6. Place the display panel inside a large box, label the box "Broken Glass," and return the display back to Apple using the normal return process.





# iMac (Late 2012 and later) and iMac Pro (2017) Required Tools

## Required Tools for iMac (Late 2012 and later) and iMac Pro (2017) Models

The following tools are required to service these models:

- iMac Pro (2017)
- iMac (Retina 5K, 27-inch, Late 2014, Mid 2015, Late 2015, 2017, 2019, and 2020)
- iMac (27-inch, Late 2012 and Late 2013)
- iMac (Retina 4K, 21.5-inch, Late 2015, 2017, and 2019)
- iMac (21.5-inch, Late 2012, Early 2013, Late 2013, Mid 2014, Late 2015, 2017)

## General Tools

- ESD-safe workstation, including an ESD mat and wrist or heel strap
- ESD bags, to store ESD-sensitive parts while removed from the computer
- ESD-safe tweezers.
- Black stick or other nonconductive nylon or plastic flat-bladed tool
  - Black stick, pack of 4 (922-5065)
  - Black stick, pack of 24 (922-9004)
  - Black stick, pack of 96 (922-9005)
- Digital volt meter, for troubleshooting
- Earphones, for audio cable reassembly
- Kapton tape
- Magnifying glass, for reading the serial number
- Pentalobe driver (923-0367), for VESA mount
- Phillips #00 screwdriver
- Sticky notes
- Thunderbolt and USB cables, for logic board replacement
- Torx T4 screwdriver (magnetized)
- Torx T5 screwdriver (magnetized)
- Torx T6 screwdriver (magnetized)
- Torx T8 screwdriver (magnetized)
- Torx T10 screwdriver (magnetized)
- Torx T25 screwdriver (magnetized), for 27-inch models
- Adjustable torque driver 0.3–1.2 Nm (923-0735)
- T8 security bit (923-0734)
- Logic Board Service Tray (076-00376)
- Phillips PH2 bit
- Access Card for iMac Pro (923-02298)

## Display Tools

The display is secured to the rear enclosure using adhesive strips. When a repair requires the removal of the display panel, the very high bond (VHB) adhesive strips must be cut and replaced.

## Display starter kit and refill kits

Model	Starter kit	Refill kit
iMac (21.5-inch, Late 2012)	076-1444	076-1437
iMac (21.5-inch, Early 2013)	076-1444	076-1437
iMac (21.5-inch, Late 2013)	076-1444	076-1437
iMac (21.5-inch, Mid 2014)	076-1444	076-1437
iMac (21.5-inch, Late 2015)	076-1444	076-1437
iMac (21.5-inch, 2017)	076-00330	076-00331
iMac (Retina 4K, 21.5-inch, Late 2015)	076-1444	076-1437
iMac (Retina 4K, 21.5-inch, 2017)	076-00330	076-00331
iMac (Retina 4K, 21.5-inch, 2019)	076-00330	076-00331
iMac (27-inch, Late 2012)	076-1444	076-1419
iMac (27-inch, Late 2013)	076-1444	076-1419
iMac (Retina 5K, 27-inch, Late 2014)	076-1444	076-00009
iMac (Retina 5K, 27-inch, Mid 2015)	076-1444	076-00009
iMac (Retina 5K, 27-inch, Late 2015)	076-1444	076-00009
iMac (Retina 5K, 27-inch, 2017)	076-00330	076-00332
iMac (Retina 5K, 27-inch, 2019)	076-00330	076-00332
iMac (Retina 5K, 27-inch, 2020)	076-00490	076-00491
iMac Pro (2017)	076-00374	076-00375

#### Display starter kit contains:

- Display removal tool (1) (the white handle shown here), also available separately as 076-00108
- Display removal wheels (8) (the black circle on the left side of tool shown here)

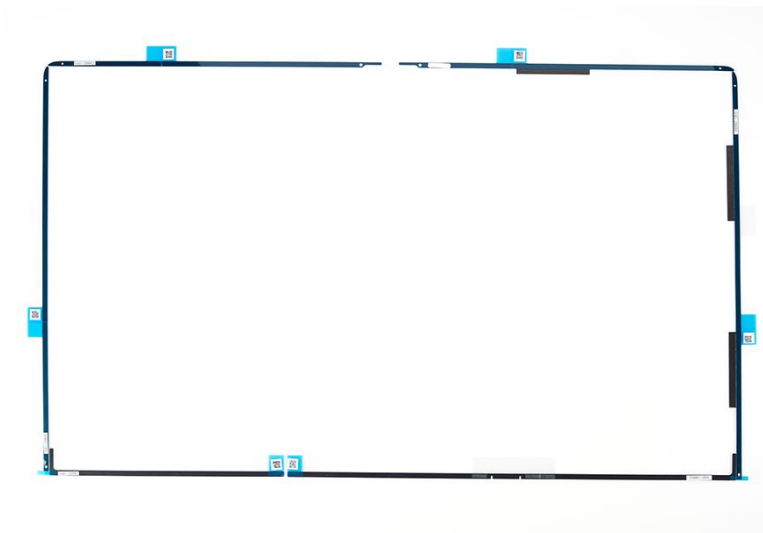


- iMac service wedge (not available separately)

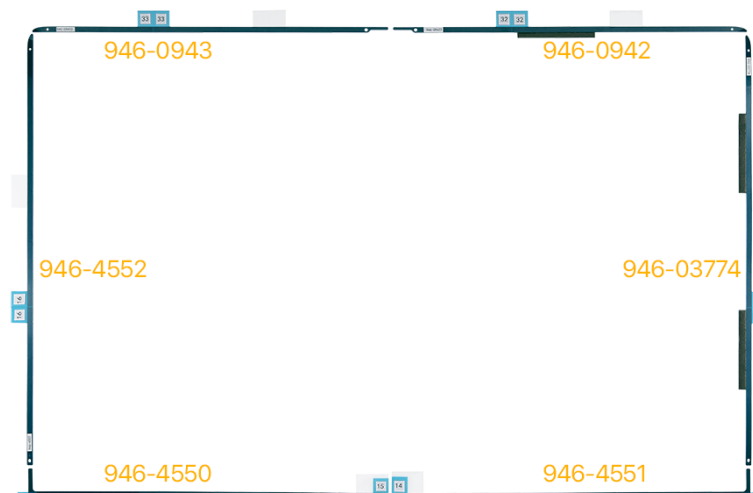
**Note:** The number on the side of the service wedge (944-4365) is an Apple internal part number used for identification. It is not an orderable service part.



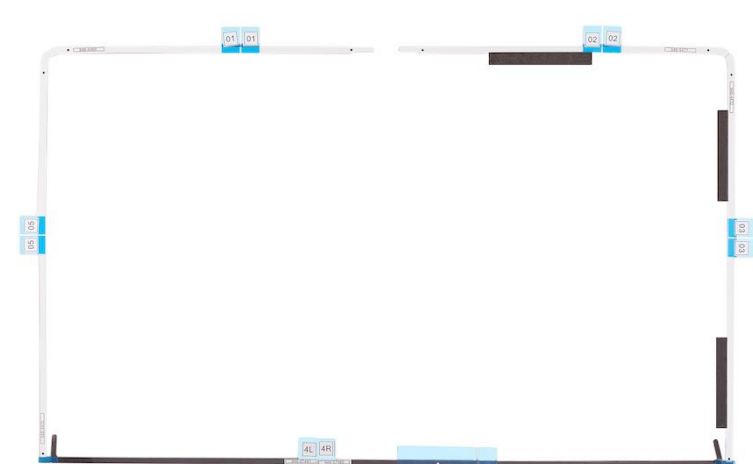
- VHB adhesive strip 6-piece set for iMac (Retina 5K, 27-inch, 2020).



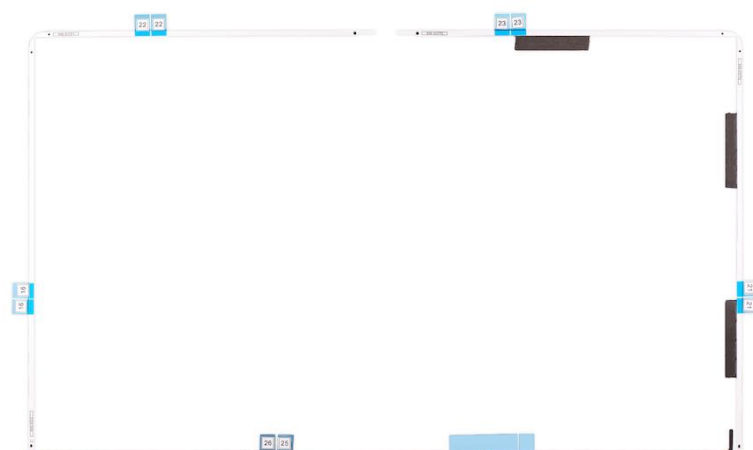
- VHB adhesive strip 6-piece set for iMac Pro (2017)



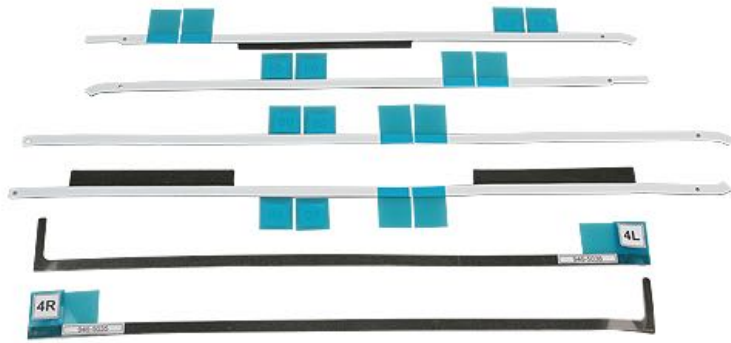
- VHB adhesive strip 6-piece set for iMac (Retina 4K, 21.5-inch, 2017 and 2019)



- VHB adhesive strip 6-piece set for iMac (Retina 5K, 27-inch, 2017 and 2019)



- VHB adhesive strip 6-piece set for iMac (21.5-inch, Late 2012–Mid 2015 models)



#### Display refill kits contain:

- Display removal tool (1), also available separately as 076-00108
- Display removal wheels (20), also available separately as 076-1417
- VHB adhesive strip 6-piece set (20 sets)

#### Other display tools:

- Display cable extension kit, to test the display and cables with the display removed

Model	Extension Kit
iMac (21.5-inch, Late 2012)	076-1428
iMac (21.5-inch, Early 2013)	076-1428
iMac (21.5-inch, Late 2013)	076-1428
iMac (21.5-inch, Mid 2014)	076-1428
iMac (21.5-inch, Late 2015)	076-1428
iMac (21.5-inch, 2017)	076-1428
iMac (Retina 4K, 21.5-inch, Late 2015)	076-00200
iMac (Retina 4K, 21.5-inch, 2017)	076-00373
iMac (Retina 4K, 21.5-inch, 2019)	076-00373
iMac (27-inch, Late 2012)	076-1431
iMac (27-inch, Late 2013)	076-1431
iMac (Retina 5K, 27-inch, Late 2014)	076-00010
iMac (Retina 5K, 27-inch, Mid 2015)	076-00010
iMac (Retina 5K, 27-inch, Late 2015)	076-00010
iMac (Retina 5K, 27-inch, 2017)	076-00010
iMac (Retina 5K, 27-inch, 2019)	076-00010
iMac (Retina 5K, 27-inch, 2020)	076-00010
iMac Pro (2017)	076-00377

- Apple polishing cloth for displays with nano-texture glass (923-04724)
- Display removal tool (076-00108)
- Display removal wheels, pack of 20 (076-1417)
- ESD bags, 27x18-inch, pack of 5 (923-01193), for a 27-inch display
- ESD bags, 21x16-inch, pack of 5 (923-01194), for a 21.5-inch display
- Gloves, anti-static and lint-free (922-8253) for handling displays with nano-texture glass
- Isopropyl alcohol (IPA) wipes, 95% or higher isopropyl
- iMac LCD service support stand (923-0416), to support the display or when working on a VESA rear housing.



- Painter's tape (tape that does not leave a residue, 1 to 2 inches or 2.5 to 5 cm wide, but preferably 2-inch or 5 cm, if available)
- Polishing cloths, anti-static, optical-grade microterry, pack of 5 (922-8263)
- Power supply protective covers (923-0189), to use when performing live adjustments with the display removed
- Sticky silicone roller (6-inch) (922-8261), to adhere display adhesive (VHB) strips to the display
- Sticky sheet pads (922-8262), to clean silicone roller or pick up shards of broken glass

### Wireless Card Tools

- Thermal pad kit (076-1445)  
**Note:** Whenever removing or replacing the wireless card, check for any original thermal material. If it is present, then remove the original thermal material, clean the area with an IPA wipe, and install one thermal pad to the wireless card.
- Antenna tool (optional)
  - 923-01322



- Wireless card support tools
  - 923-03086 for iMac (Retina 4K, 21.5-inch, 2019)



- 923-03085 for iMac (Retina 5K, 27-inch, 2019) and iMac (Retina 5K, 27-inch, 2020)



- 923-02218 for iMac Pro (2017)



- 923-01806 for iMac (21.5-inch, 2017) and iMac (Retina 4K, 21.5-inch, 2017)



- 923-01807 for iMac (Retina 5K, 27-inch, 2017)



- 923-00774 for iMac (21.5-inch, Late 2015) and iMac (Retina 4K, 21.5-inch, Late 2015)



- 923-00775 for iMac (Retina 5K, 27-inch, Late 2015)



# Take-Apart Procedure Notes

## Reassembly Steps

When the take-apart procedure doesn't include a final list of parts that you need to reinstall to complete reassembly, reinstall parts in the reverse order in which they're listed in the beginning of the Removal section.

## Images

Some service guide articles include images of preproduction devices. There may be small differences between the image shown and the device you're servicing, but the procedures are the same unless noted.

## Screw Sizes

All screw sizes are about the total length of the screw.





# iMac (Retina 5K, 27-inch, 2019 and 2020) Memory

## First Steps

### Before you Begin:

- Shut down the computer, unplug the power cord and disconnect all peripherals.
- Lay the computer face down on a soft, clean towel or cloth to prevent scratching the display.
- **Caution:** Wear lint-free gloves (922-8253) when handling an iMac with a nano-texture display. Use only the Apple nano-texture polishing cloth (923-04724) to clean the nano-texture glass.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).



## Tools

No tools are required for this procedure.

## Steps For Removal

1. Open the memory compartment door by pressing the small grey button located just above the AC power port.



2. The memory compartment door will open as the button is pushed in. Remove the compartment door and set it aside.  
**Note:** A diagram on the underside of the memory cover shows the memory cage levers and the orientation of the DIMM.



3. Locate the two levers on the right and left sides of the memory cage. Push the two levers outward to release the memory cage:



4. After the memory cage is released, pull the memory cage levers toward you, allowing access to each DIMM slot.



5. Remove a DIMM by pulling the module straight up and out. Note the location of the notch on the bottom of the DIMM. When reinstalling DIMMs, the notch must be oriented correctly or the DIMM won't fully insert.



### Steps For Reassembly

1. Replace or install a DIMM by setting it down into the slot and pressing firmly until you feel the DIMM click into the slot. **Important:** Ensure the DIMM is fully seated and has clicked into place. If the DIMM is not fully seated, the computer may not recognize the DIMM and may not turn on.

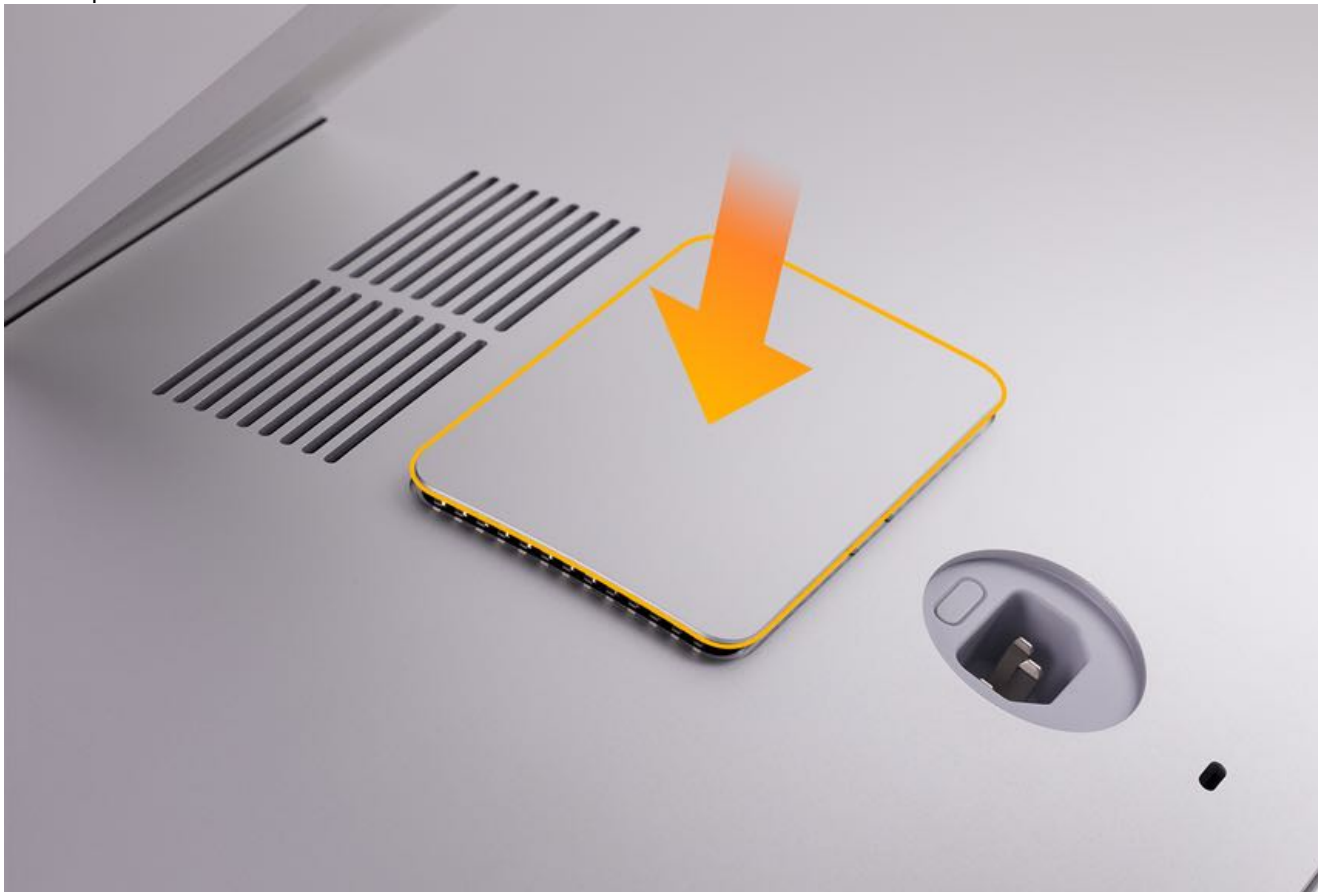


2. After you install all of your DIMMs, push the memory cage levers back into the housing until they click back into place.





3. Replace the memory compartment door. You don't need to press the compartment door release button when replacing the compartment door.



4. Place the computer in its upright position. Reconnect the power cord and all other cables to the computer, then start up the computer.

# iMac (Retina 5K, 27-inch, 2020) Display Removal

## First Steps

### Before you begin:

- Turn off the computer and disconnect all external cables.
- Unplug the power cord from the electrical outlet and wait two minutes for the power supply and logic board to discharge.



### Warning! Electrical Shock Hazard:

- Never plug the computer in to an electrical outlet during a repair procedure.
  - The power supply and logic board remain powered when the computer is plugged in whether or not the computer has been turned on.
  - After unplugging the computer from the electrical outlet, wait two minutes for the power supply and logic board to discharge before removing the display, disconnecting modules, or substituting cables and components.
  - Do not perform any troubleshooting until [protective covers](#) (TP833) have been installed over the power supply and logic board.
  - Additional [safety precautions](#) (TP820) must be followed when performing troubleshooting that requires you to operate the computer when it is plugged into an electrical outlet and the display is removed.
- 

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).
- Wear lint free gloves (922-8253) when handling an iMac that has a nano-texture glass display. Use only the Apple polishing cloth (923-04724) to clean the nano-texture glass.

### Important:

- You must perform [System Configuration](#) (TP1657) after a display or logic board repair.

### Note:

- Some of the images in this procedure show the 2019 model, however the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).



## Tools

1. iMac service wedge
2. Black stick
3. Display removal tool and replacement wheels
4. Safety glasses
5. Isopropyl alcohol (IPA) wipes
6. iMac LCD service support stand (923-0416)

Required for nano-texture glass display, but not shown in image:

- Apple polishing cloth for nano-texture glass (923-04724)
- Gloves, anti-static and lint-free (922-8253)



The display is attached to the rear housing with very high bond (VHB) adhesive strips. Each VHB strip has one foam layer surrounded by two adhesive layers. To remove the display, you must use the display removal tool to cut the VHB strips. When you cut the VHB strips, you are cutting mostly through the foam layer. The display removal tool has replaceable wheels that you can use five to ten times. If a wheel is nicked, you must replace it.



## Steps For Removal



**Warning:** In the unlikely event that the display glass cracks or breaks, refer to [Cleaning and Handling a Broken Display \(TP819\)](#).

1. Place the service wedge on the stand with the AC power port and stand hole covered. Rotate the computer so the display is facing you.





2. Insert the display removal tool at a 90 degree angle in the top left corner between the display and rear housing. Roll the tool across the top of the computer, avoiding the 3-inch (7.6cm) area surrounding the camera.  
**Caution:** Failure to lift the display removal tool out of the computer to avoid the camera could damage the display and the camera.



3. Continue to roll the display removal tool around the top right corner and down along the right side of the computer.



**Note:** Ensure that the display removal tool makes steady contact with the display and rear housing at the top corners.

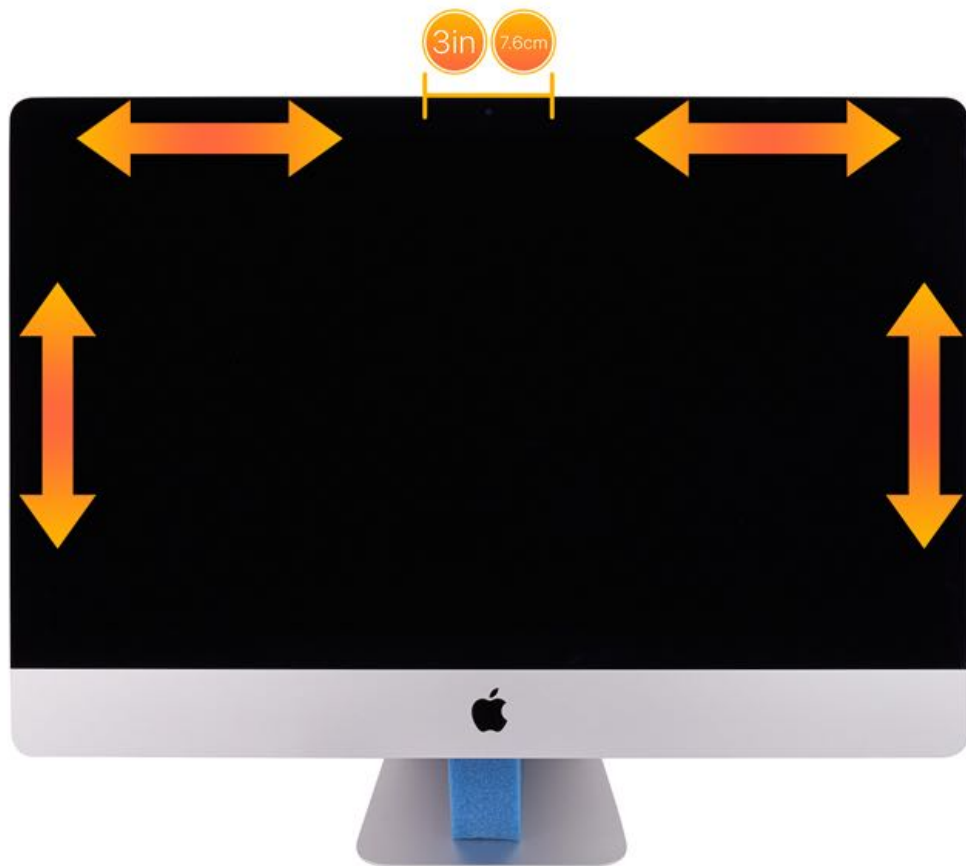


4. Roll the display removal tool around the top left corner and down along the left side of the computer.



5. Roll the display removal tool back and forth along the top and sides of the computer until the wheel moves with minimal resistance.

**Note:** Use the display removal tool only along the top and sides of the computer.



6. Insert the flat end of a black stick up to the notch between the display and rear housing. Slide the black stick along the edge to cut any remaining adhesive.



**Warning:** Don't twist, pry, or insert the black stick past its notch especially along the antenna sections. Forcing the black stick between the display and the rear housing may fracture the display.



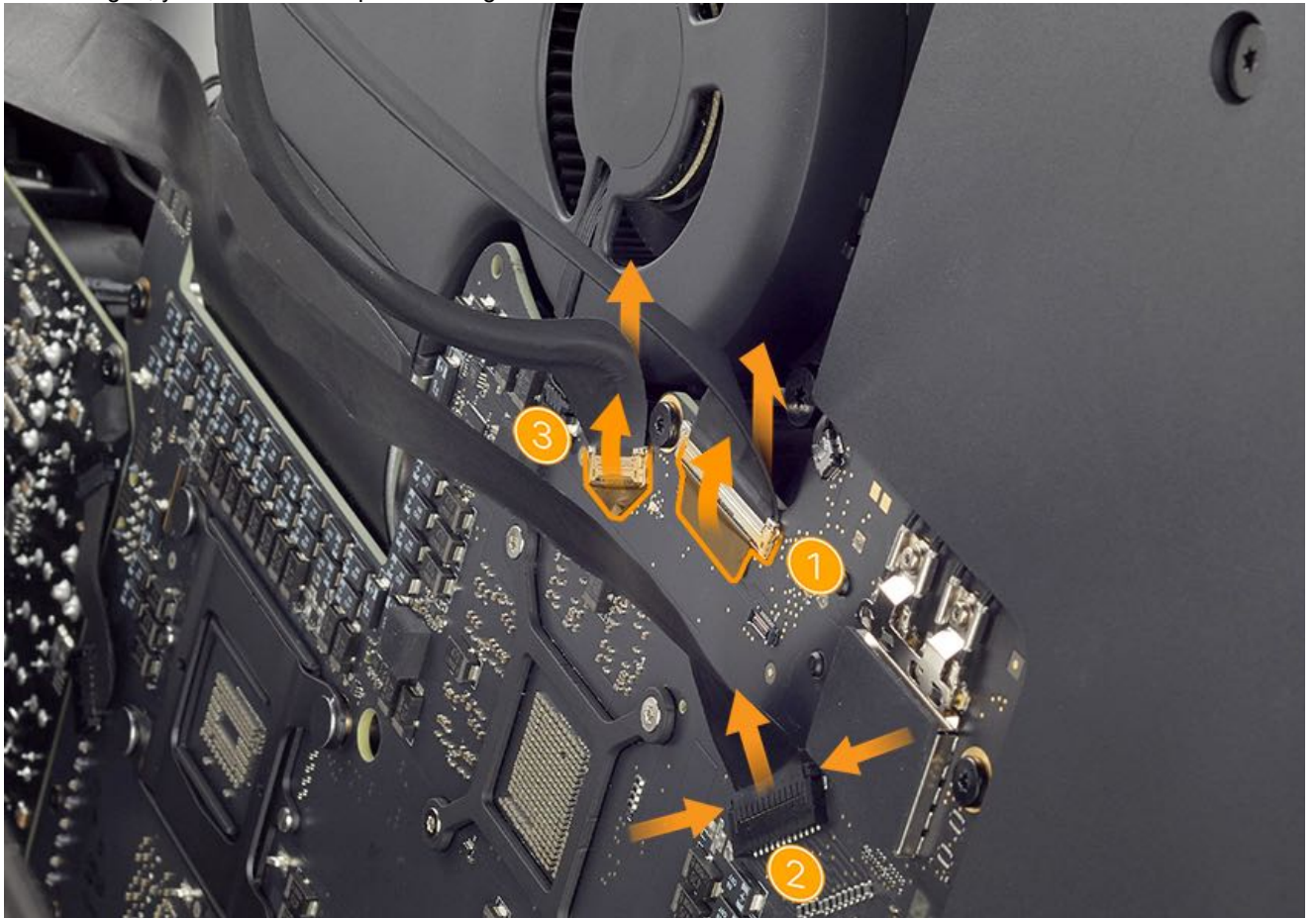
7. Separate the display from the top of the rear housing. If there is resistance, repeat steps 2 through 6.



8. Tilt the display open just enough for your hand to reach the cables connecting the display to the logic board. Disconnect the embedded DisplayPort (eDP) cable (1), the display backlight power cable (2), and the camera cable (3) from the logic board.



**Caution:** Do not attempt to remove the display. The bottom edge is still attached with display adhesive. Do not stress the display cables and connectors on the logic board when tilting the display open. If the connectors on the logic board are damaged, you will need to replace the logic board.



9. Use your hand to support the display as you further tilt it toward you.





10. Locate the display adhesive tabs at the bottom corners of the display and pull each toward the center to release the display from the rear housing.  
**Note:** If the display is sticking to the rear housing, use a black stick to break the display adhesive bond.

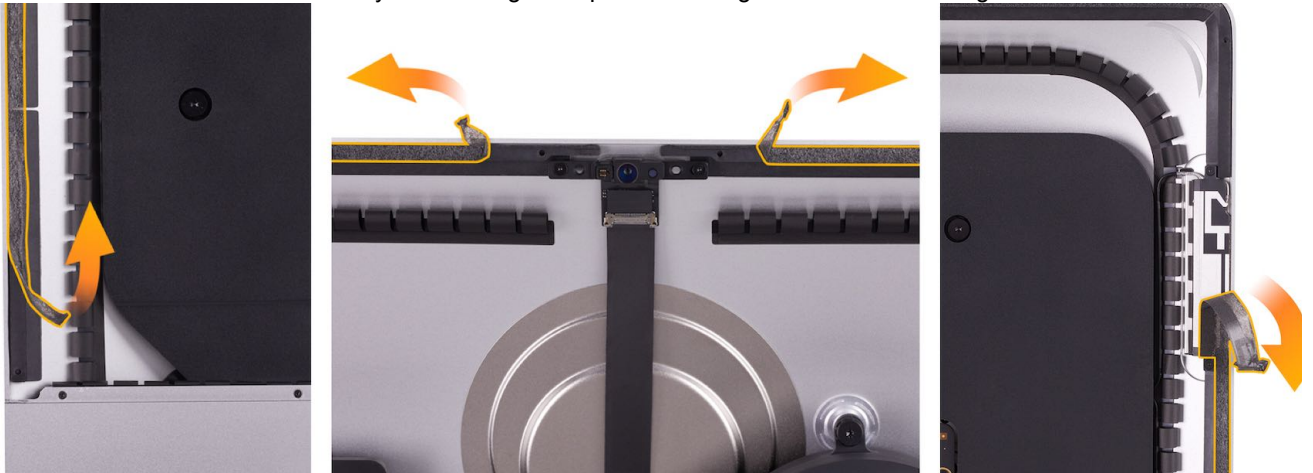


11. Pull the display from the rear housing and set it on the display support stand.





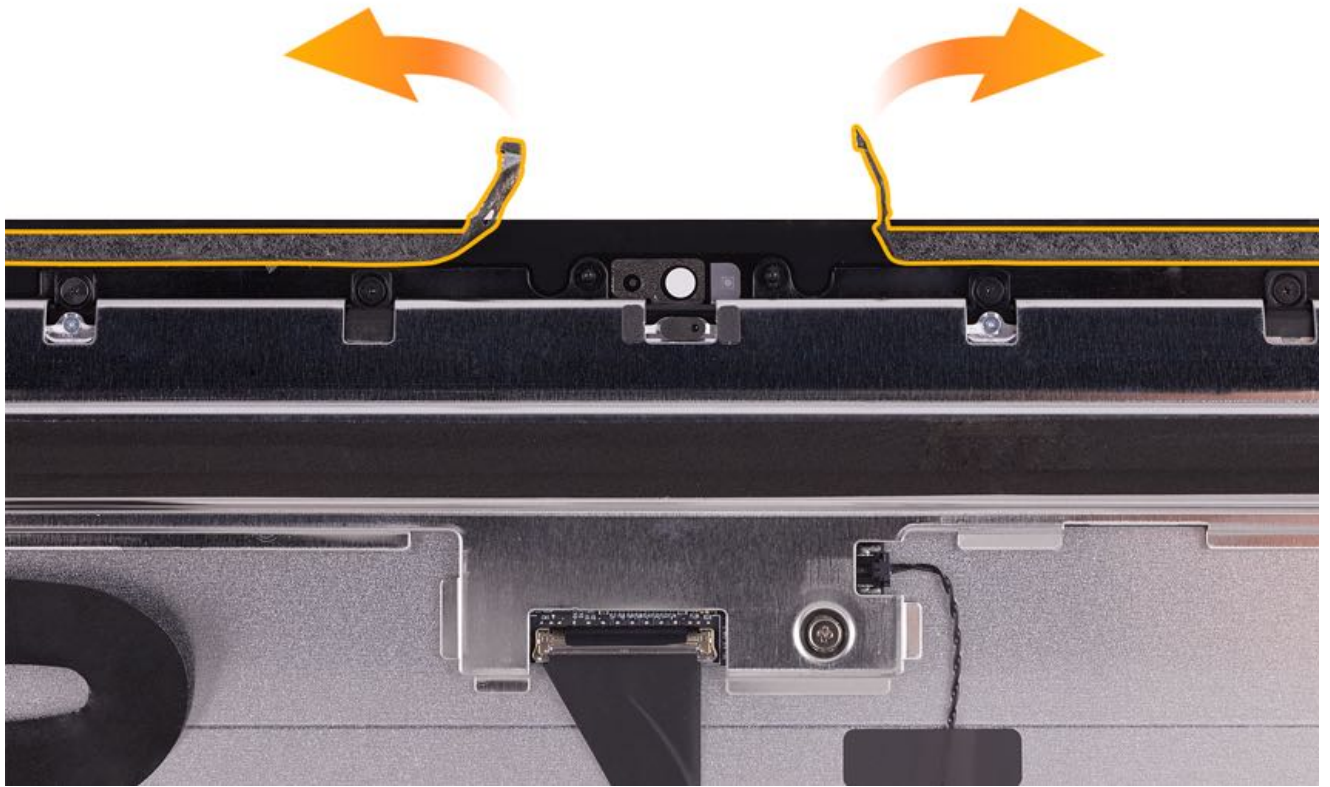
12. Use your fingers and the flat end of a black stick to remove any residual adhesive from the rear housing.  
**Note:** Residual adhesive can be anywhere along the top and side edges of the rear housing.



13. Use your fingers and the flat end of a black stick to remove any residual adhesive from the display. Residual adhesive can be anywhere along the top and side edges of the display.



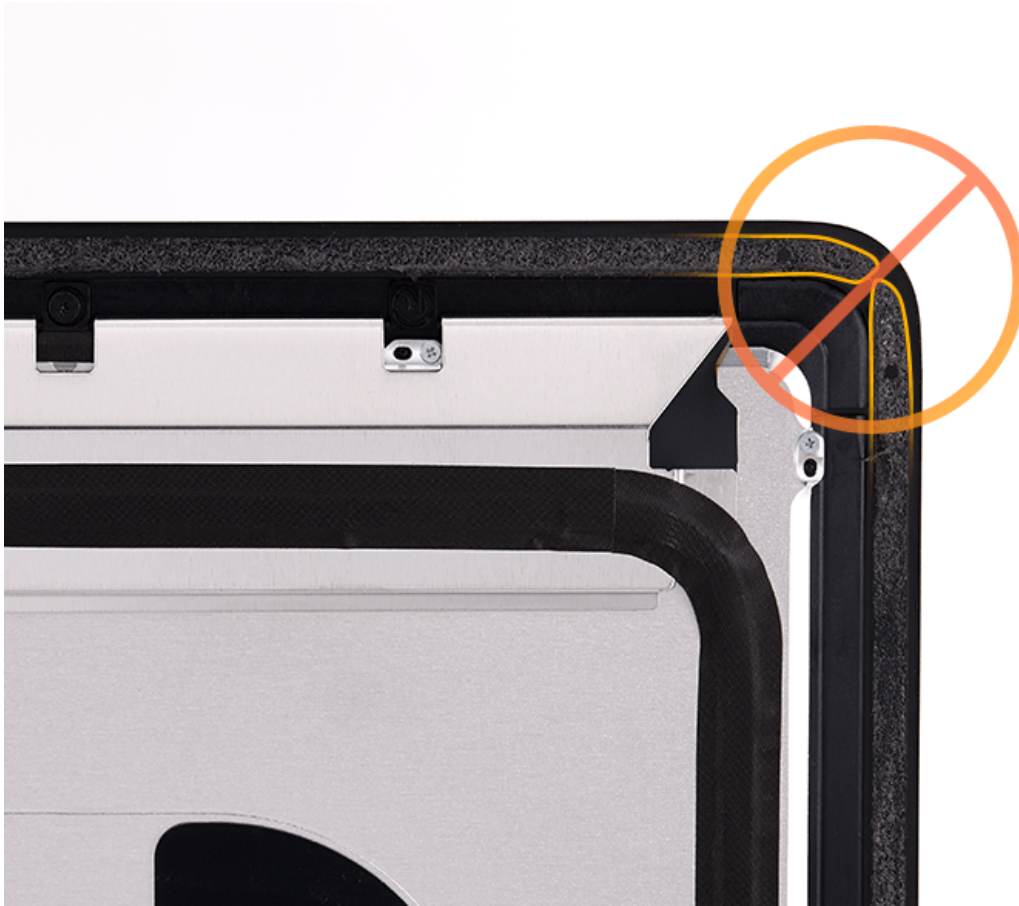
**Caution:** To prevent damaging or accidentally removing the Mylar protective film on the display glass, do not peel the residual adhesive from the top corners. Always peel the top residual adhesive outward from the center. Always peel the side residual adhesive upward from the bottom.





**Caution:** Do not peel residual adhesive inward or downward from the top corners.



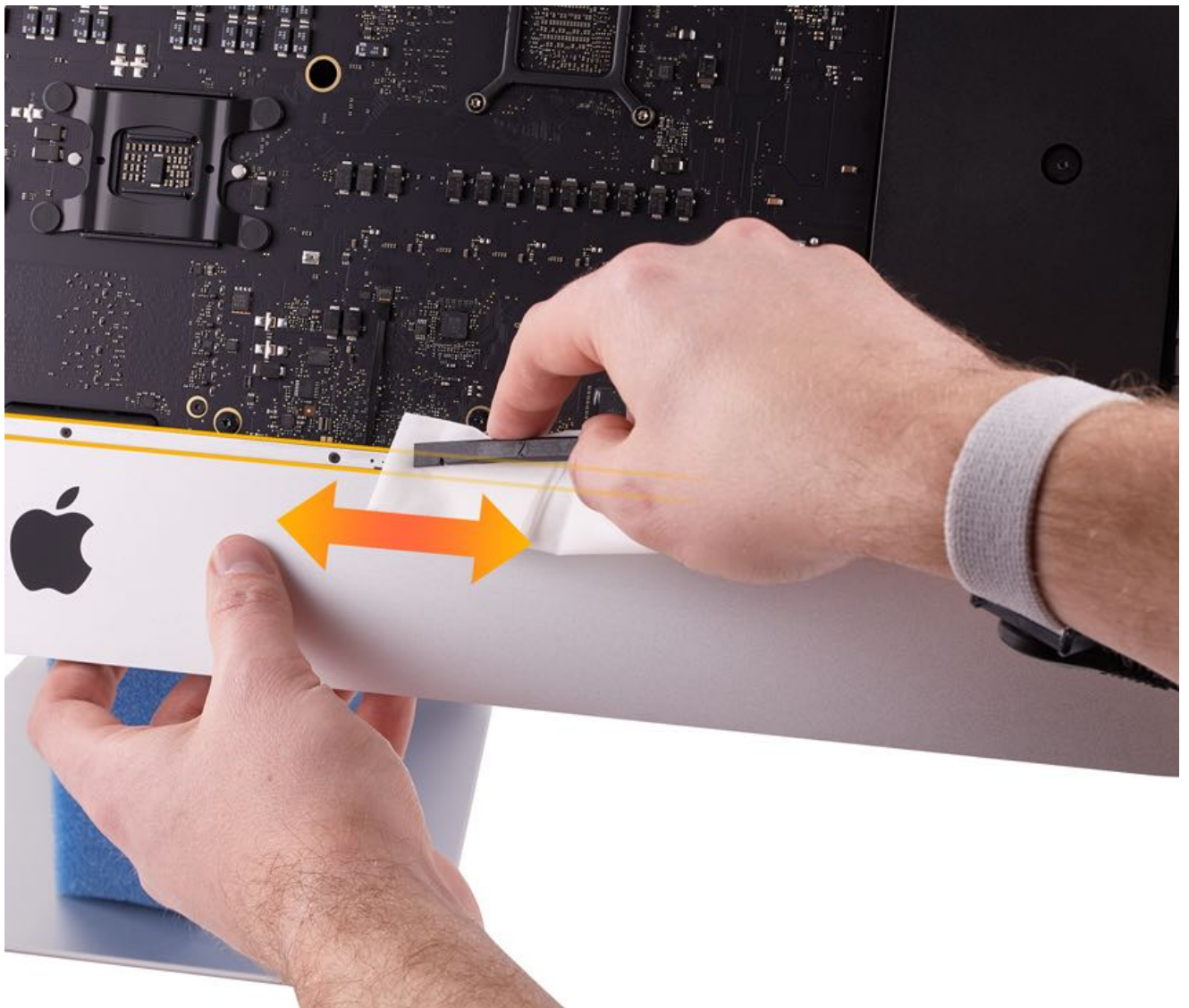


**Note:** If the black protective Mylar film is peeled or wrinkled on the display, then press the film back onto the display with your finger. The Mylar should be smooth and undamaged. Use care when working around the Mylar film. If the Mylar is pulled from the display, then you may need to replace the display.

14. Use an IPA wipe to remove any remaining adhesive from the rear housing and display edges. Allow the surfaces to dry for one minute.



**Caution:** Do not use IPA wipes on the front of the display or to remove anything other than residual adhesive.



15. Recheck the display and rear housing for any remaining residual adhesive.

### Steps For Reassembly

1. Reinstall the [display](#) to complete reassembly.
2. If you are installing a replacement display, add the display part to the repair system. Scan the 2D barcode on the original display and on the replacement display, then save the repair. This is required to run the [System Configuration](#) (TP1657) after you have reassembled the computer.





# iMac (Retina 5K, 27-inch, 2020) Display Reassembly

## First Steps



### Warning! Electrical Shock Hazard:

- Never plug the computer in to an electrical outlet during a repair procedure.
- The power supply and logic board remain powered when the computer is plugged in whether or not the computer has been turned on.
- After unplugging the computer from the electrical outlet, wait two minutes for the power supply and logic board to discharge before removing the display, disconnecting modules, or substituting cables and components.
- Do not perform any troubleshooting until [protective covers](#) (TP833) have been installed over the power supply and logic board.
- You must follow additional [safety precautions](#) (TP820) when performing troubleshooting that requires you to operate the computer when it is plugged into an electrical outlet and the display is removed.

---

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).
- Wear lint-free gloves (922-8253) when handling an iMac that has a nano-texture glass display. Use only the Apple polishing cloth (923-04724) to clean the nano-texture glass.

### Important:

- You must perform [System Configuration](#) (TP1657) after a display or logic board repair.

### Note:

- Some of the images in this procedure show iMac (Retina 4K, 21.5-inch, 2019) and iMac (Retina 5K, 27-inch, 2019), however the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).



## Tools

1. Black stick
  2. Silicone display roller
  3. iMac service wedge
  4. Isopropyl alcohol (IPA) wipes
  5. Safety glasses
  6. Clean, damp, lint-free cloth
  7. Painters tape (1 to 2 inches wide or 2.5 to 5 cm)
- Caution:** Don't use this cloth on displays with nano-texture glass

Required for displays with nano-texture glass. Not shown in image:

- Apple polishing cloth for nano-texture glass (923-04724)
- Gloves, anti-static and lint-free (922-8253)

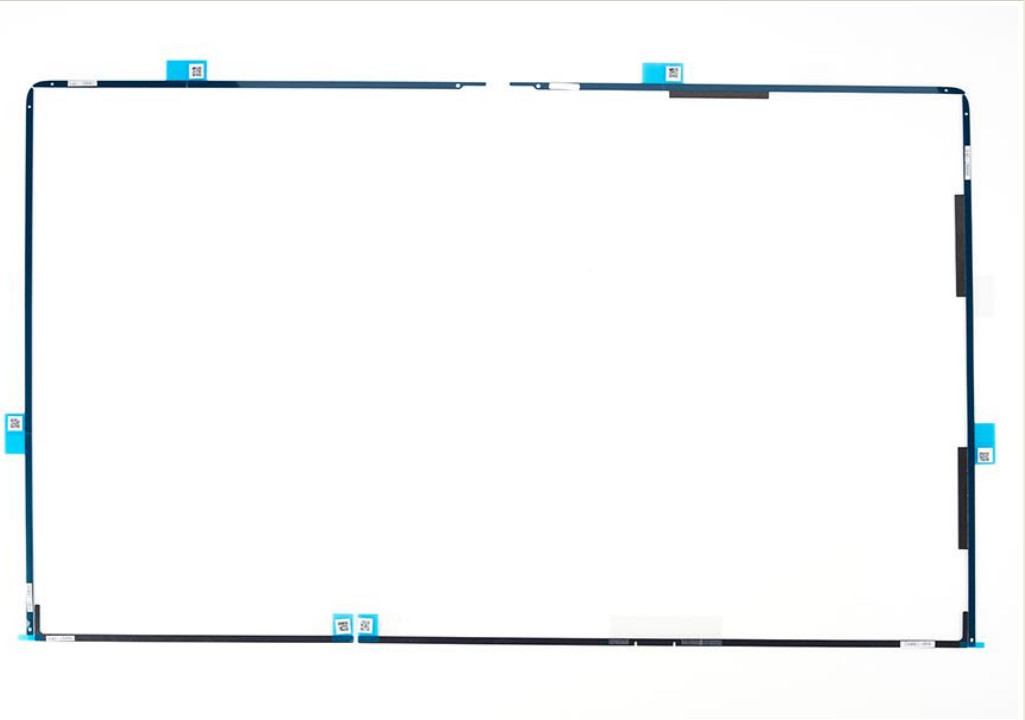


## Display Adhesive Strips

Display adhesive strips come in a starter and refill kit. Each individual display adhesive strip has a part number printed on it. Use the table and image below to verify that you have the required display adhesive strips. Lay out the display adhesive strips and check them for wrinkles and exposed sections. Damaged strips can cause cosmetic gap issues, weaken the display bond to the rear housing, or create light leakage.

- Display adhesive (VHB) starter kit: 076-00490
- Display adhesive (VHB) refill kit: 076-00491



Adhesive Strip Location	Part Number	Tap/Click Image to Enlarge
Top Left	946-18882	
Top Right	946-18884	
Left Side	946-18890	
Right Side	946-18888	
Bottom Left	946-18886	
Bottom Right	946-18892	

Steps For Removal



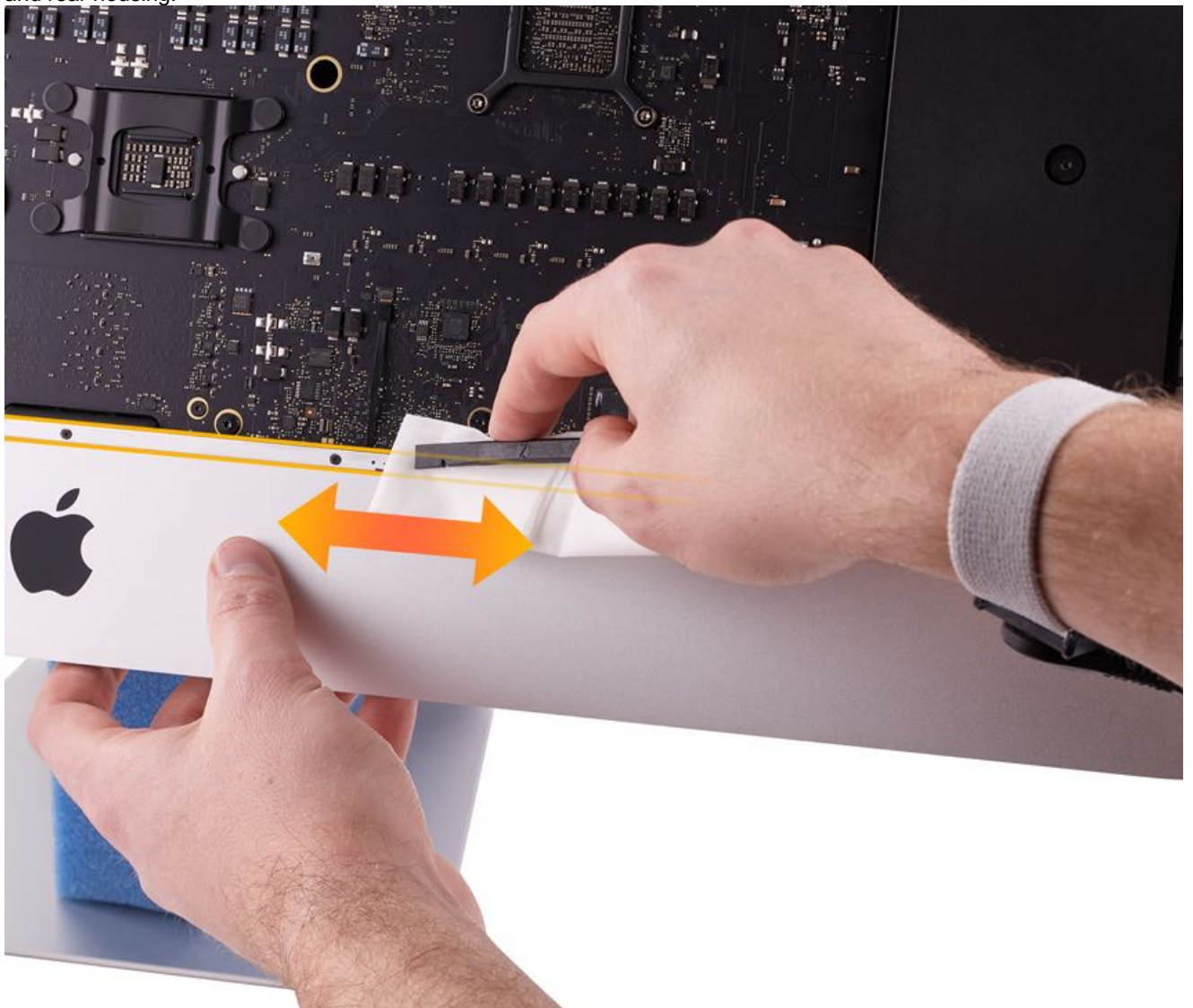
**Warning! Electrical Shock Hazard:** Verify the computer is unplugged from the electrical outlet. If the computer is plugged in to an electrical outlet, unplug it, then wait two minutes for the power supply and logic board to discharge before continuing.



1. Remove protective covers if you were performing any troubleshooting.



2. Use Isopropyl alcohol (IPA) wipes to ensure that any residual display adhesive is removed from the back of the display and rear housing.



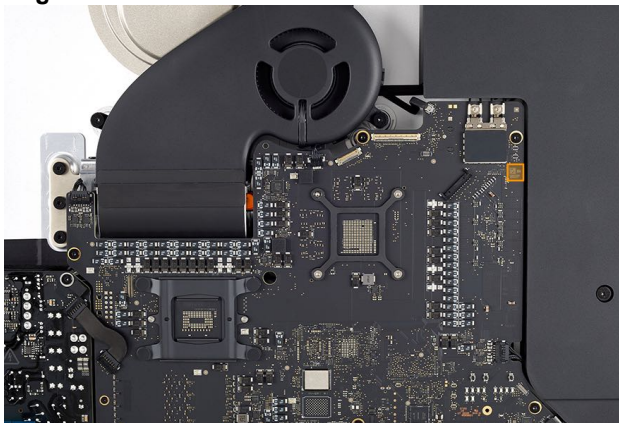
3. Verify that all internal cables are connected, all screws are installed, and that there is no debris in the computer.



4. If you are installing a replacement display or logic board, add the appropriate part to the repair system. Scan the 2D barcode on the original part and on the replacement part, then save the repair. This is required to run the [System Configuration](#) (TP1657) after you have reassembled the computer.
  - **Display 2D barcode:**



- **Logic board 2D barcode:**

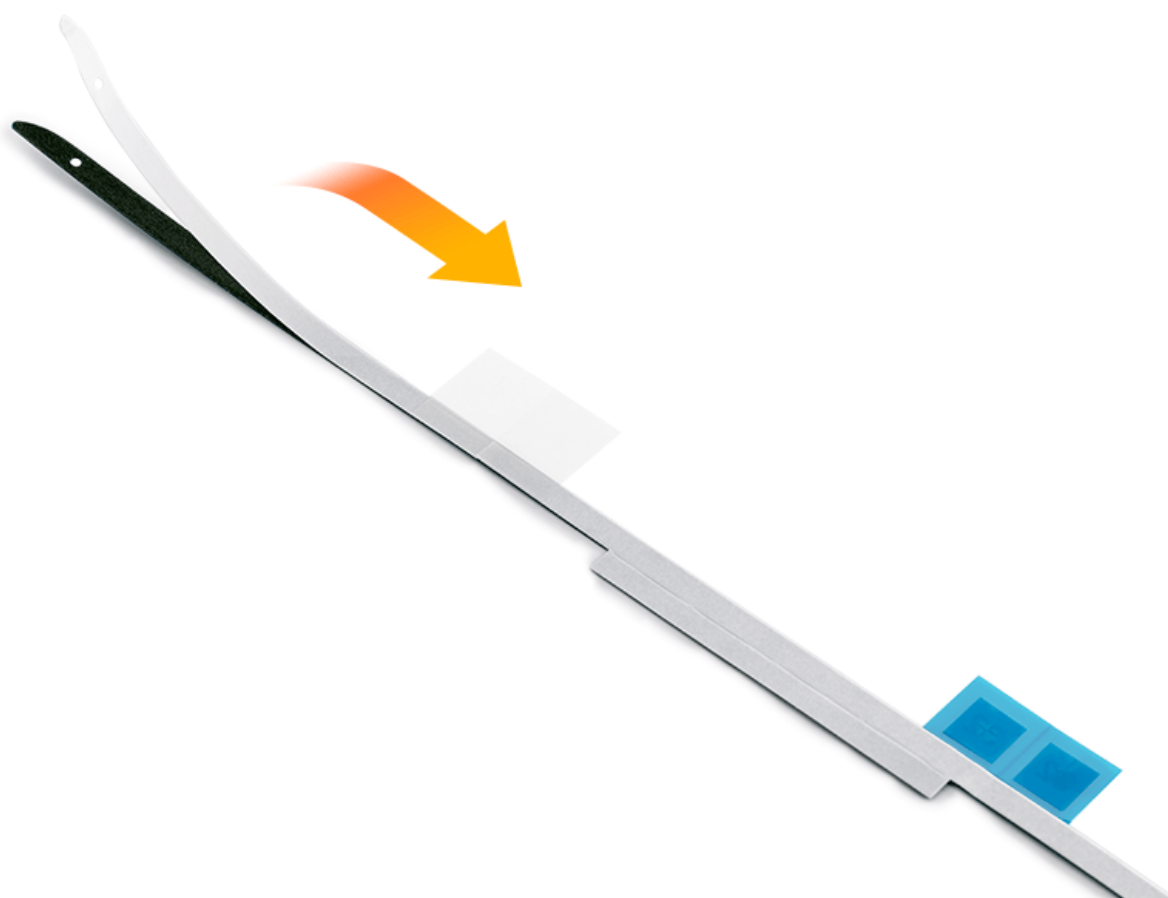


## Steps For Reassembly

### Display Adhesive Strips:

The display adhesive strips consist of two layers of very high bond (VHB) adhesive with a foam layer in the middle. There is a removable paper liner on the underside and a plastic liner on the top side. Use the pull tabs to peel the paper liners from the display adhesive strips.

**Note:** The color of the removable liner may vary.



**Alignment Holes:**

Use the eight alignment holes on the top and sides of the rear housing to align the new display adhesive strips.





#### Apply Display Adhesive Strips:

1. Use the pull tab on the back of the display adhesive strip to remove the top portion of the paper liner (1). Leave the remaining paper liner (2) on the lower half of the strip.
2. Use the pointed end of a black stick to align the display adhesive strip on one side of the rear housing.



3. As you position the top portion of the display adhesive, use the pull tab to peel the remaining paper liner from the underside of the display adhesive strip.



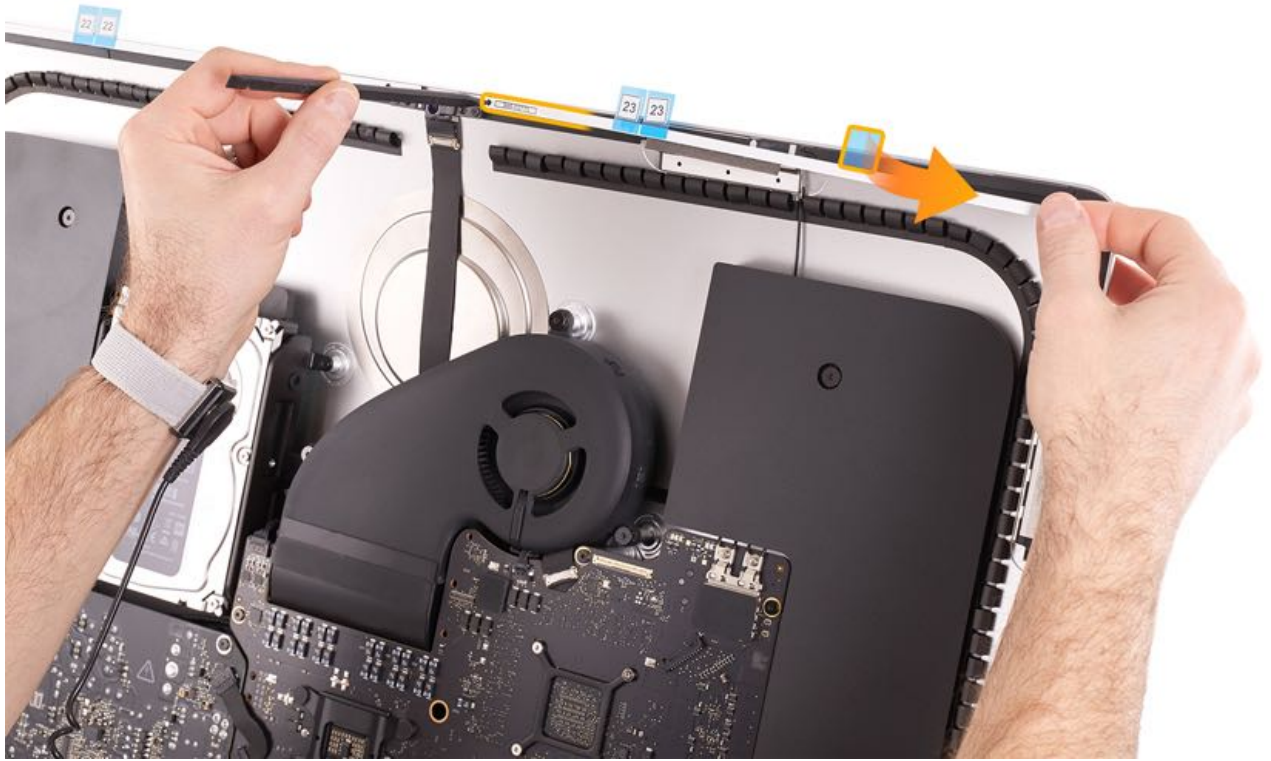
4. Use your finger to press the display adhesive strip into place on the rear housing. If a display adhesive strip does not line up correctly, remove it and start again.

**Important:** Do not remove the clear plastic liners from the top layer of the strip at this time.



5. Repeat steps 1 through 4 along the top inside edge and other side of the rear housing.

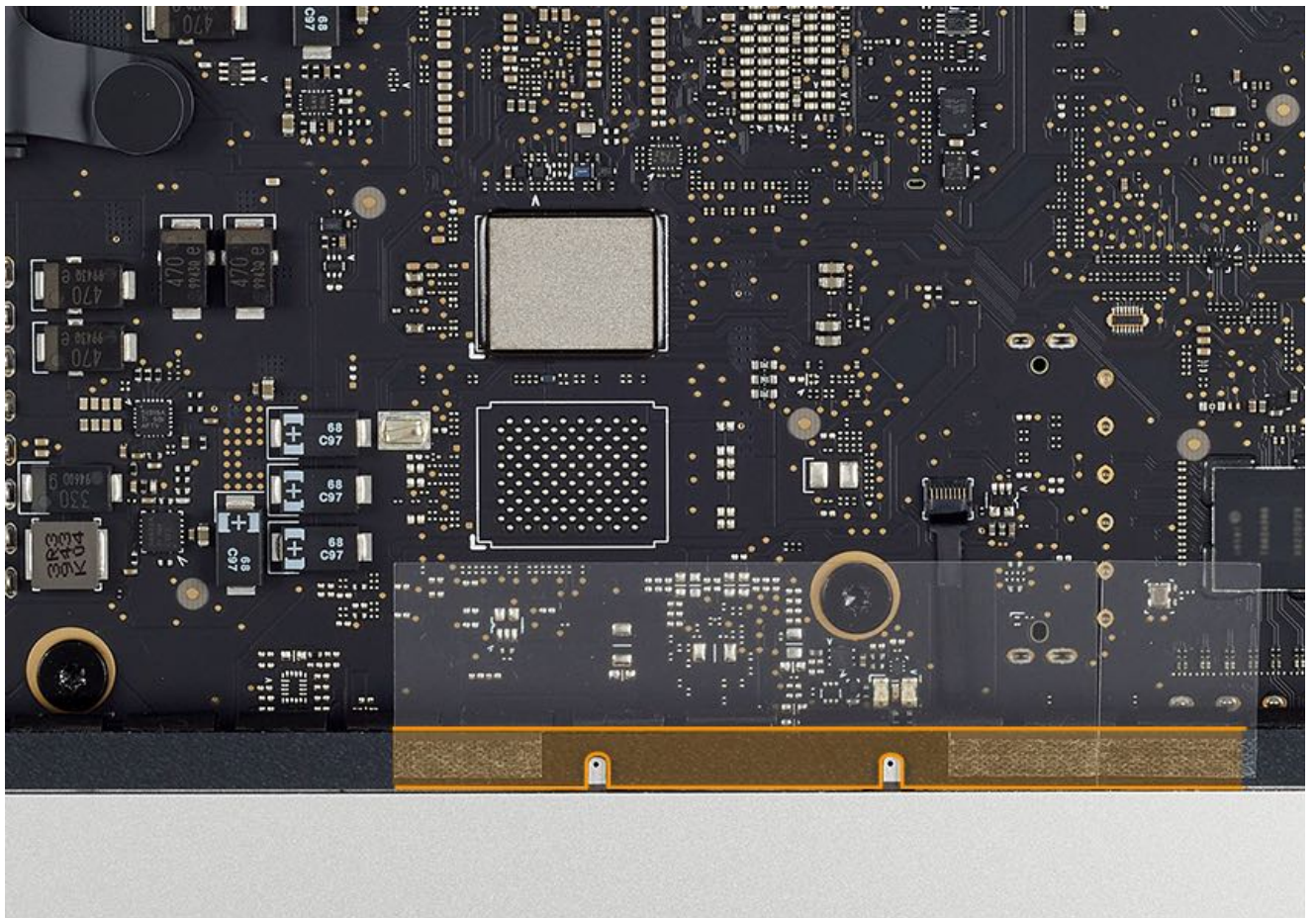




6. Adhere the two remaining strips of display adhesive along the bottom edge of the rear housing. There are no guide holes on the bottom display adhesive strips or along the bottom of the rear housing, so align the strips by hand.



7. Don't cover the dual chin microphones when applying the bottom right display adhesive strip. Align the two notches in the adhesive strip with the two microphone holes shown in the image below.



8. If a display adhesive strip does not line up correctly, remove it, clean the rear housing, and start again. Check that there are no wrinkles or exposed sections on the strip.



#### Install the Display:

9. Place the display on the chin of the rear housing. Align the display and check that it is centered and seated.





10. Hold the display removal tool against the sides of the display to check the alignment. Adjust if necessary.



11. Anchor the display to the chin with a horizontal strip of painters tape. Place the tape along the chin, where the bottom of the display meets the rear housing.



12. Stand back to check the alignment of the display. If you can see the rear housing, adjust the display and check again.

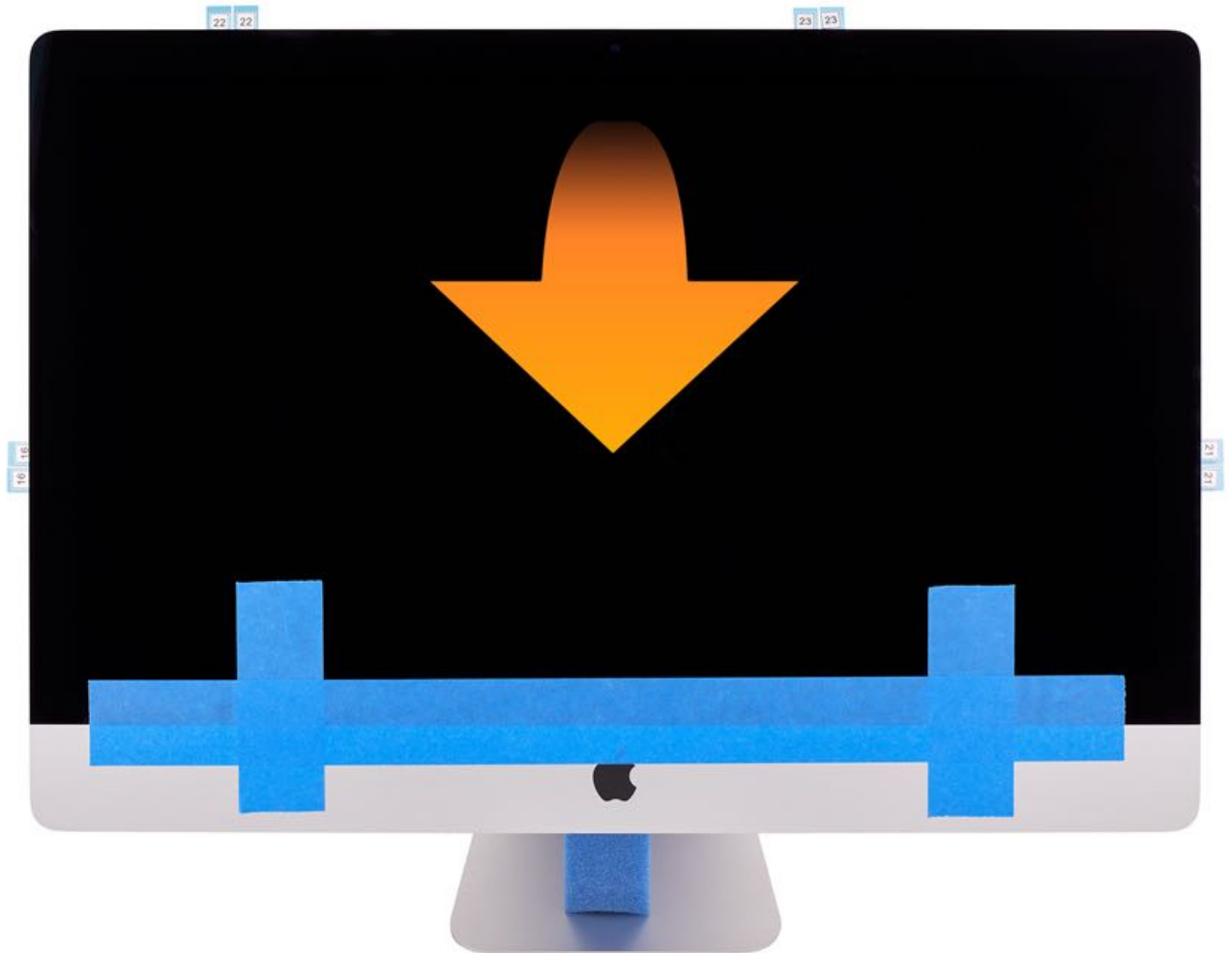
**Incorrect alignment**



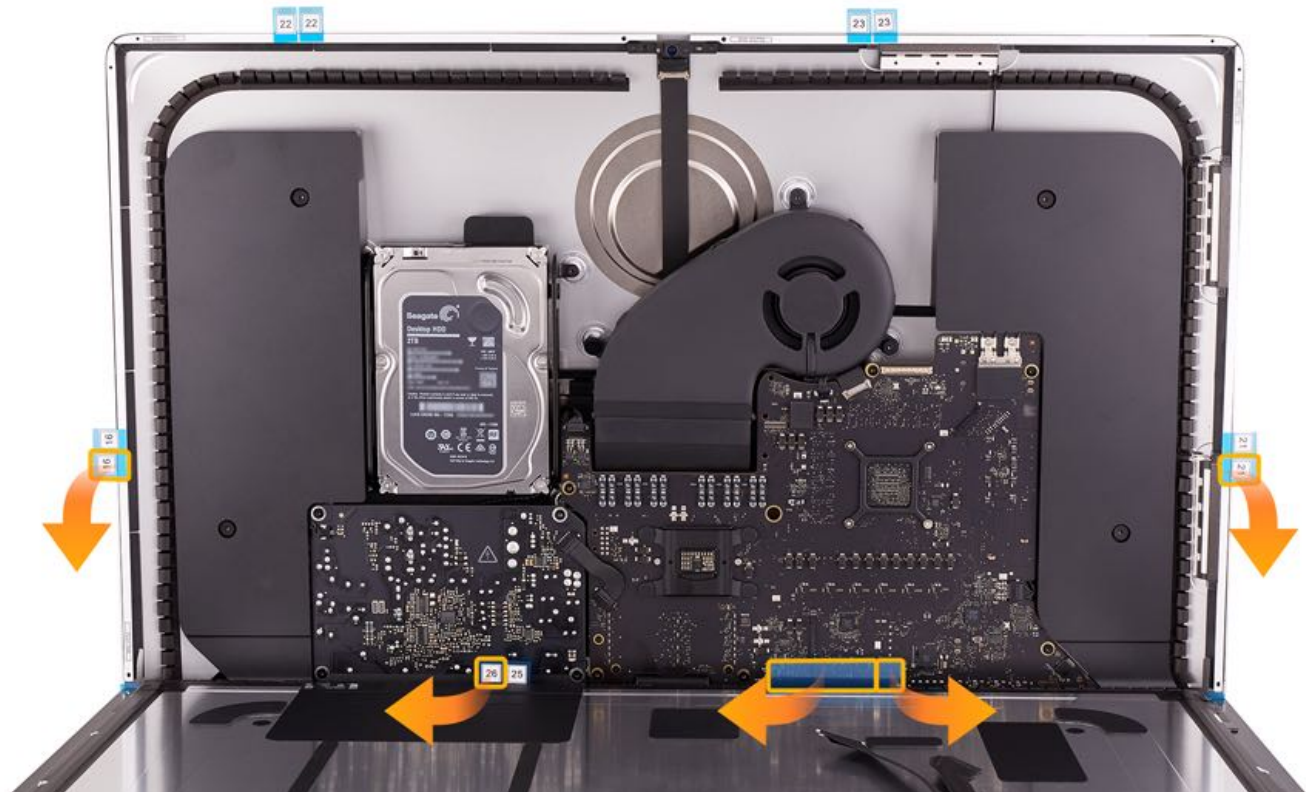
**Correct alignment**



13. Anchor the display further with two vertical strips of painters tape. Use one hand to tilt the display down while steadying it with the other hand.



14. While continuing to steady the display with one hand, use the other hand to pull the clear release liners from the adhesive strips on the chin and bottom sides of the rear housing.  
**Note:** Slowly pull the release liners so they do not tear or break.



15. Tilt up the display, leaving enough room to connect the camera cable, embedded DisplayPort (eDP) cable, and display backlight power cable to the logic board. Check that the cables are firmly seated.  
**Important:** Do not stress the display cables and connectors on the logic board. If the connectors are damaged, you will need to replace the logic board.





16. Close the locking levers on the camera cable and eDP cable.

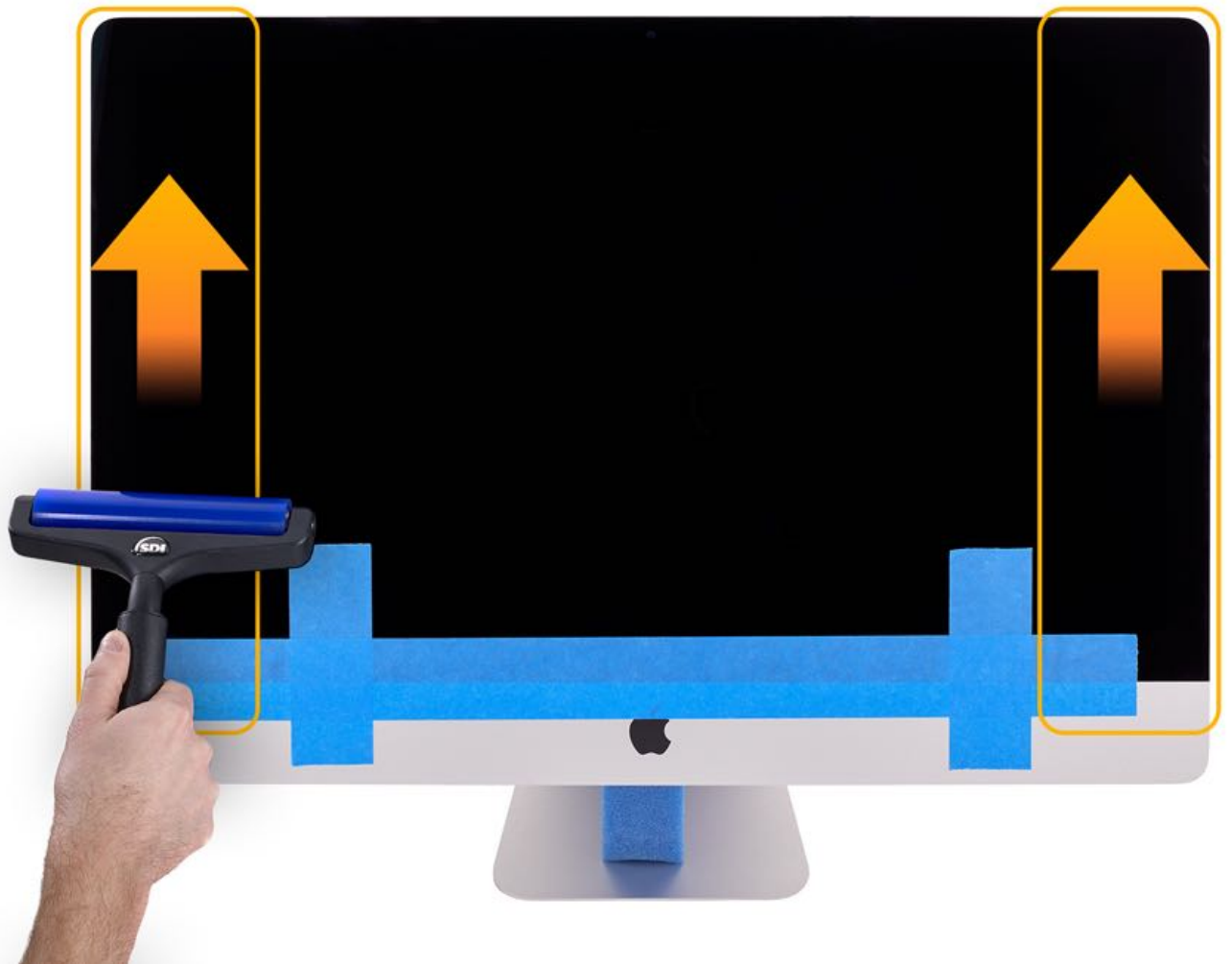


17. Remove the remaining release liners from the top and sides of the rear housing. After you've removed all the release liners, lean the display against the rear housing.

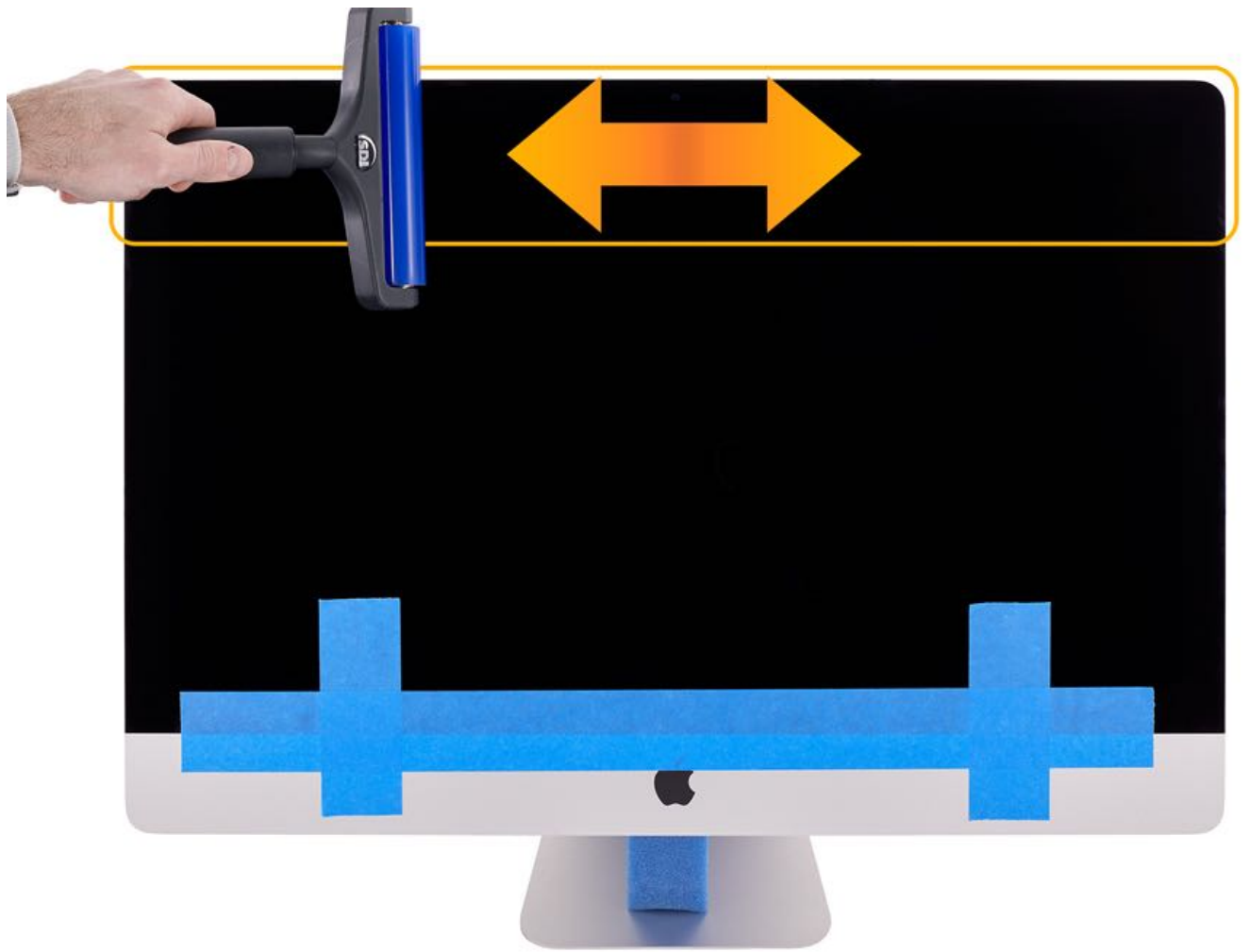




18. Use the silicone display roller to adhere the display adhesive strips to the glass. To prevent image quality issues, roll from the bottom up only.



19. Roll along the top in a horizontal back-and-forth motion.



20. Remove the painters tape and clean the front of the display.

**Caution:** For displays with nano-texture glass, use only the Apple polishing cloth (923-04724).



21. If you replaced the display or logic board, run [System Configuration](#) .
22. Run the [required AST 2 diagnostics for the parts that you replaced](#) .

# iMac (Retina 5K, 27-inch, 2020) Camera Cable

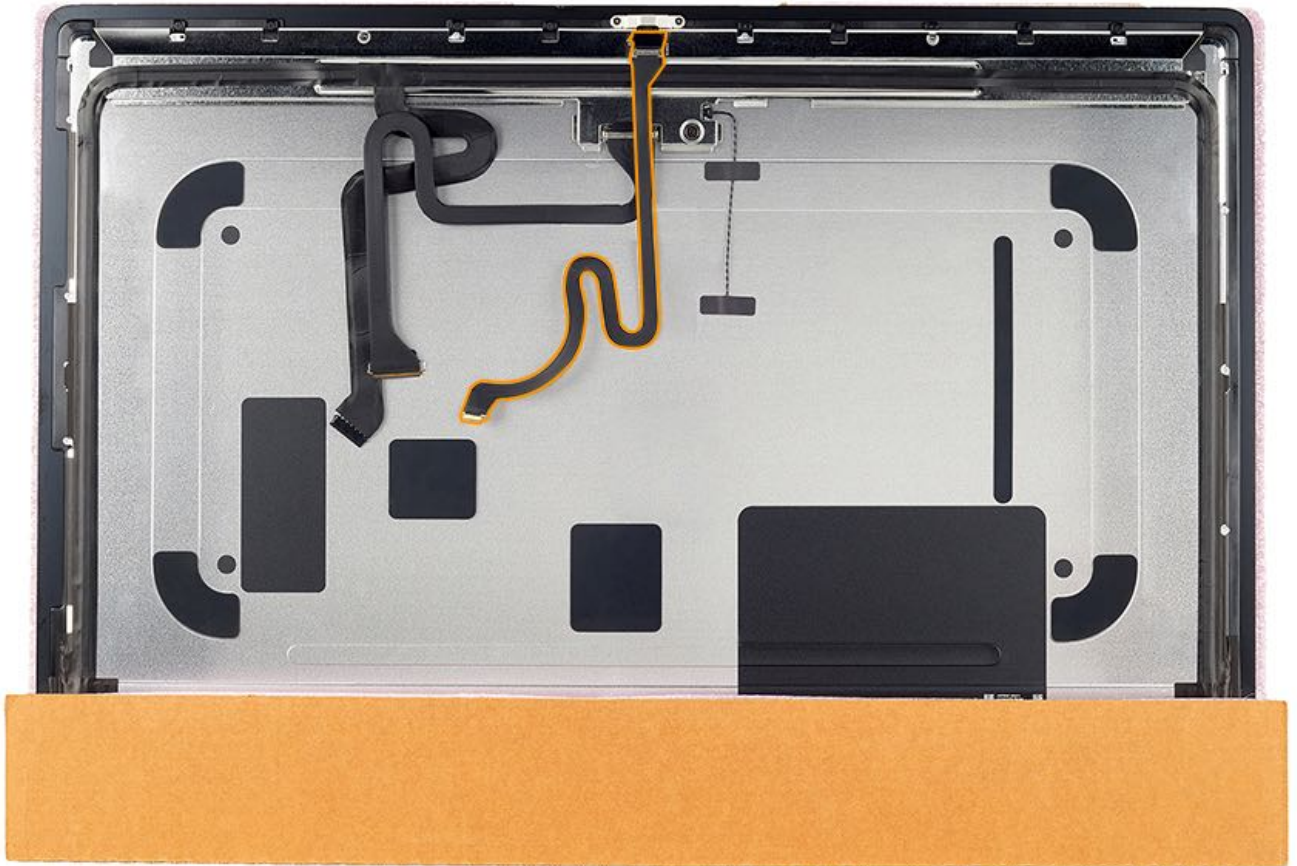
## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).
- Wear lint-free gloves (922-8253) when handling an iMac that has a nano-texture glass display. Use only the Apple polishing cloth (923-04724) to clean the nano-texture glass.

### Remove:

- [Display](#)



## Tools

1. Black stick
2. iMac LCD service support stand (923-0416)

Required for displays with nano-texture glass. Not shown in image:

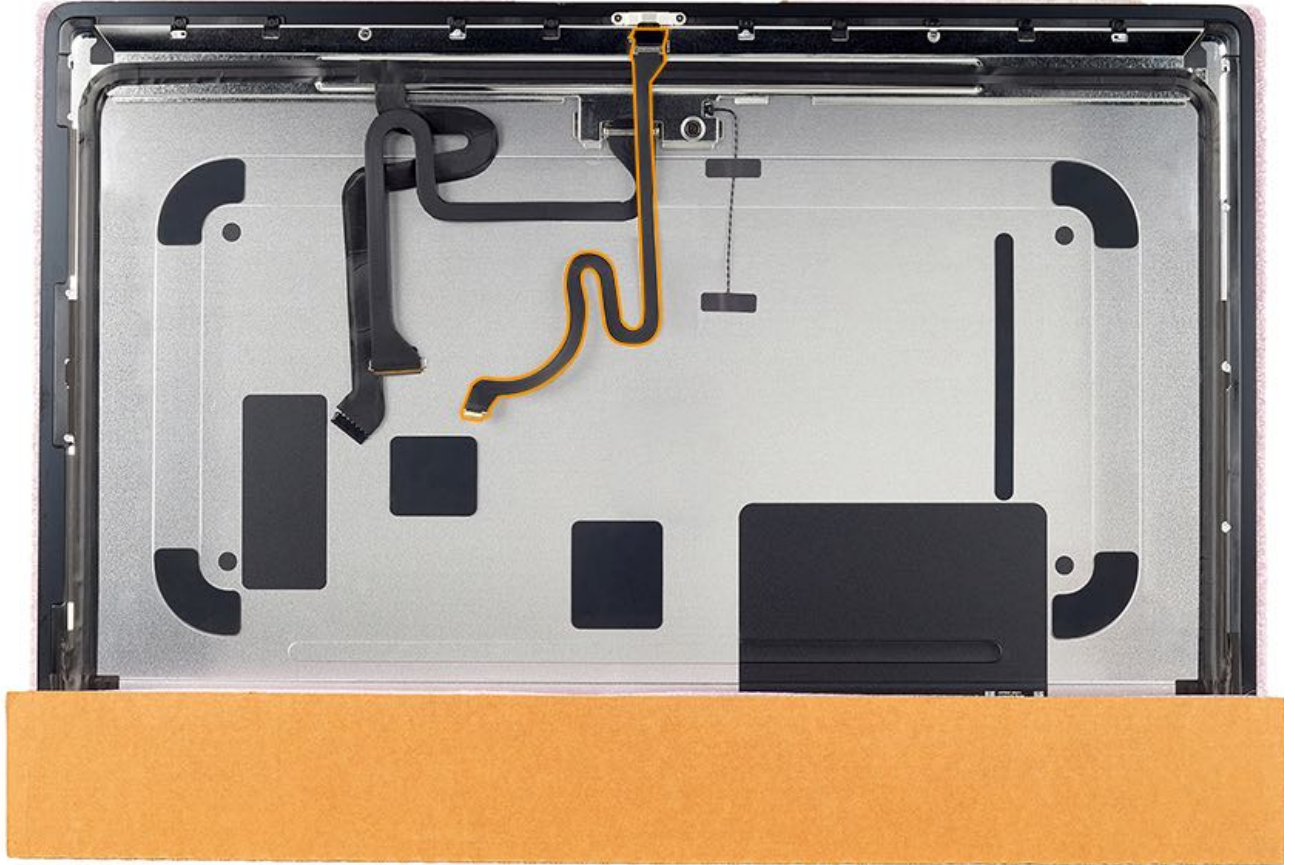
- Apple polishing cloth for nano-texture glass (923-04724)
- Gloves, anti-static and lint-free (922-8253)



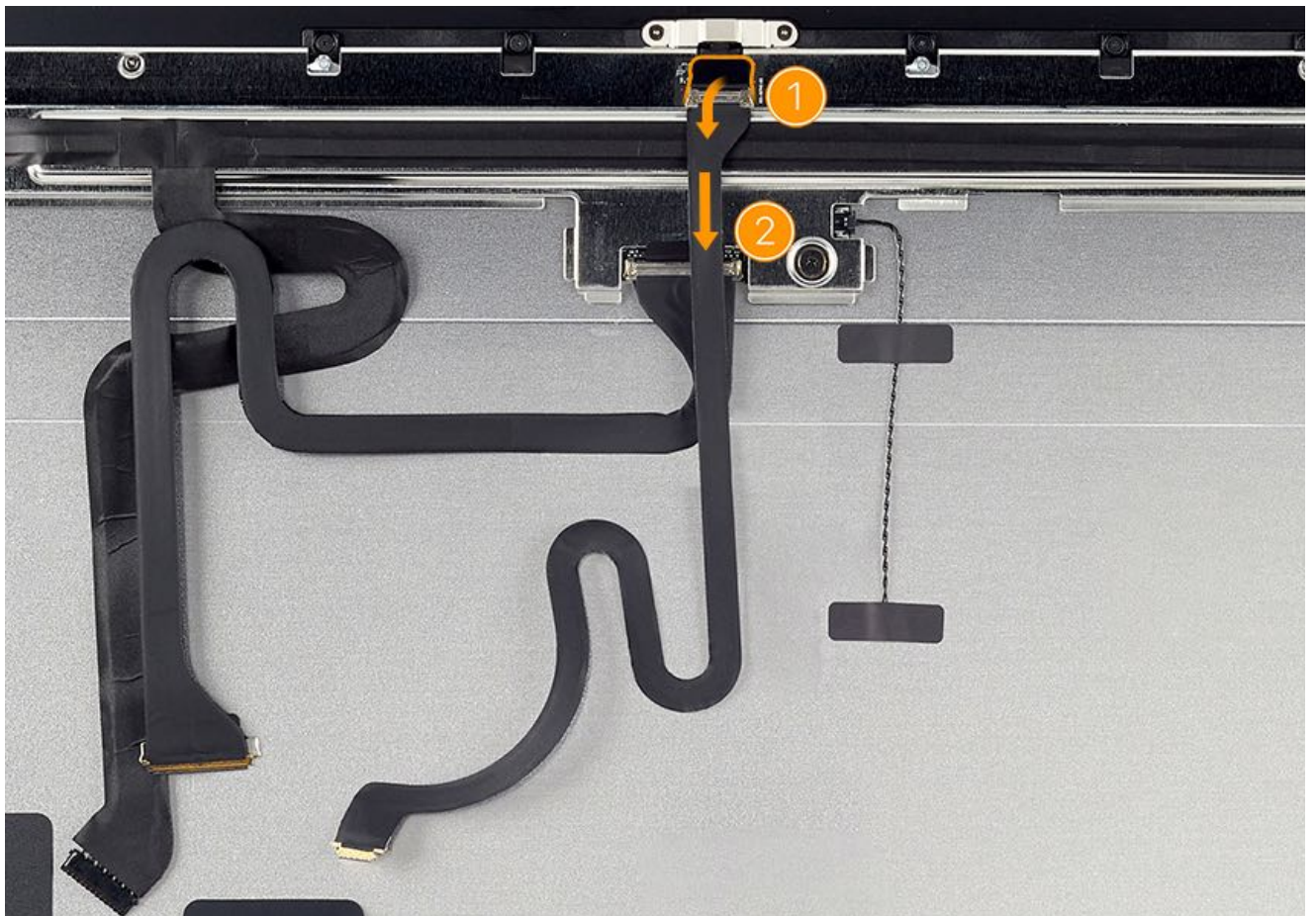


## Steps For Removal

1. Place the display on the iMac service support stand with the cables facing you.



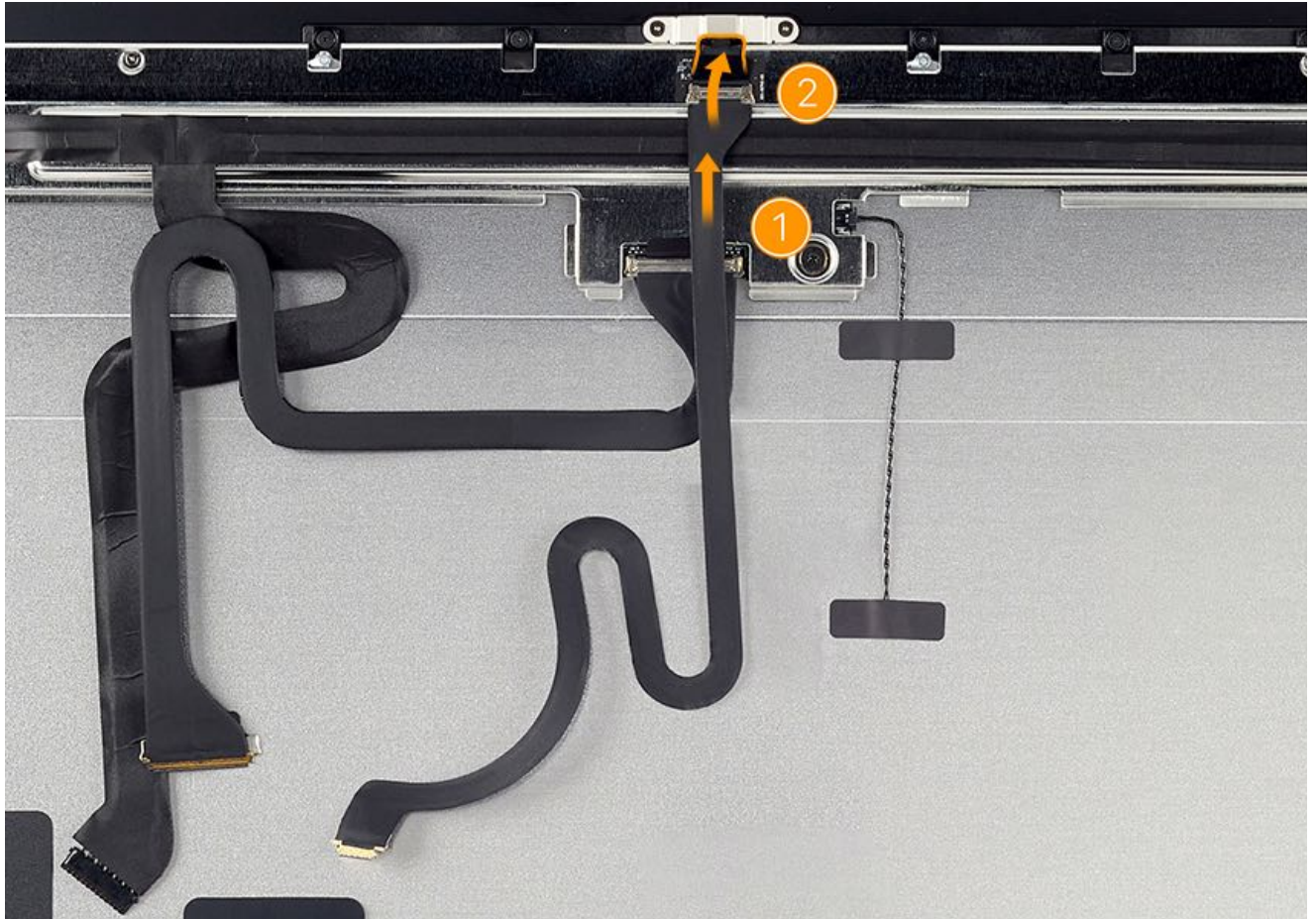
2. Lift the locking lever on the camera cable (1), then pull down to disconnect the cable (2).



## Steps For Reassembly

1. Connect the camera cable to the camera connector (1) on the back of the display, then close the locking lever (2) on the camera cable. Press gently on the camera cable—just below the connector—for 15 seconds to adhere it to the back of the display.

**Important:** If installing a replacement camera cable, remove the adhesive backing located just below the connector on the cable.



2. Reinstall the [display](#) to complete reassembly.



# iMac (2019 and 2020) Display Thermal Sensor Cable

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).
- Wear lint-free gloves (922-8253) when handling an iMac that has a nano-texture glass display. Use only the Apple polishing cloth (923-04724) to clean the nano-texture glass.

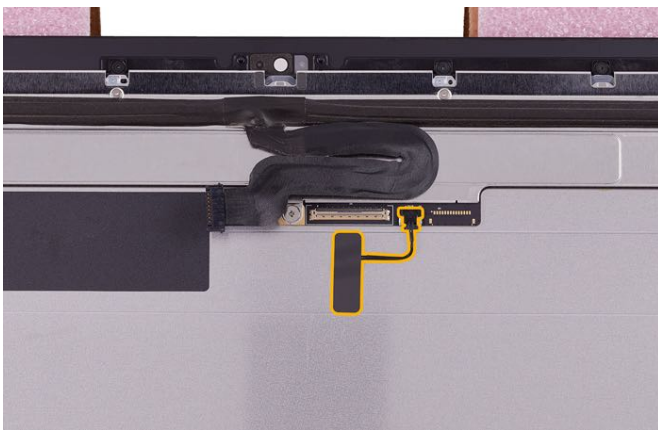
### Important:

- This procedure is shared between iMac (Retina 4K, 21.5-inch, 2019) iMac (Retina 5K, 27-inch, 2019) and iMac (Retina 5K, 27-inch, 2020). Images in this shared procedure may show one model, but the steps to perform the repair are the same for all.

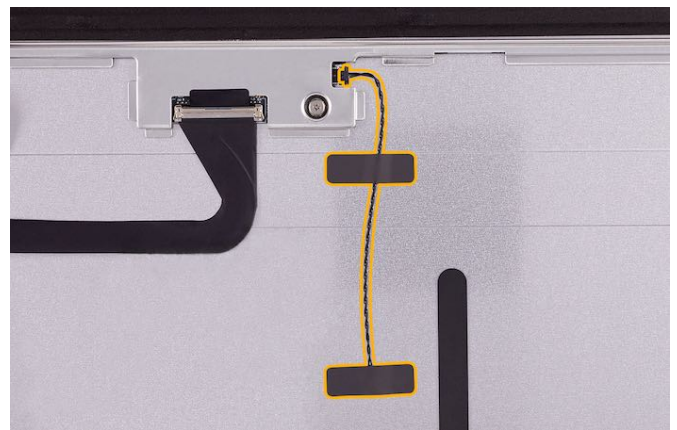
### Remove:

- [Display removal](#) (2019)
- [Display removal](#) (2020)

iMac (Retina 4K, 21.5-inch, 2019)



iMac (Retina 5K, 27-inch, 2019 and 2020)



## Tools

1. Black stick
2. iMac LCD service support stand (923-0416)

Required for displays with nano-texture glass. Not shown in image:

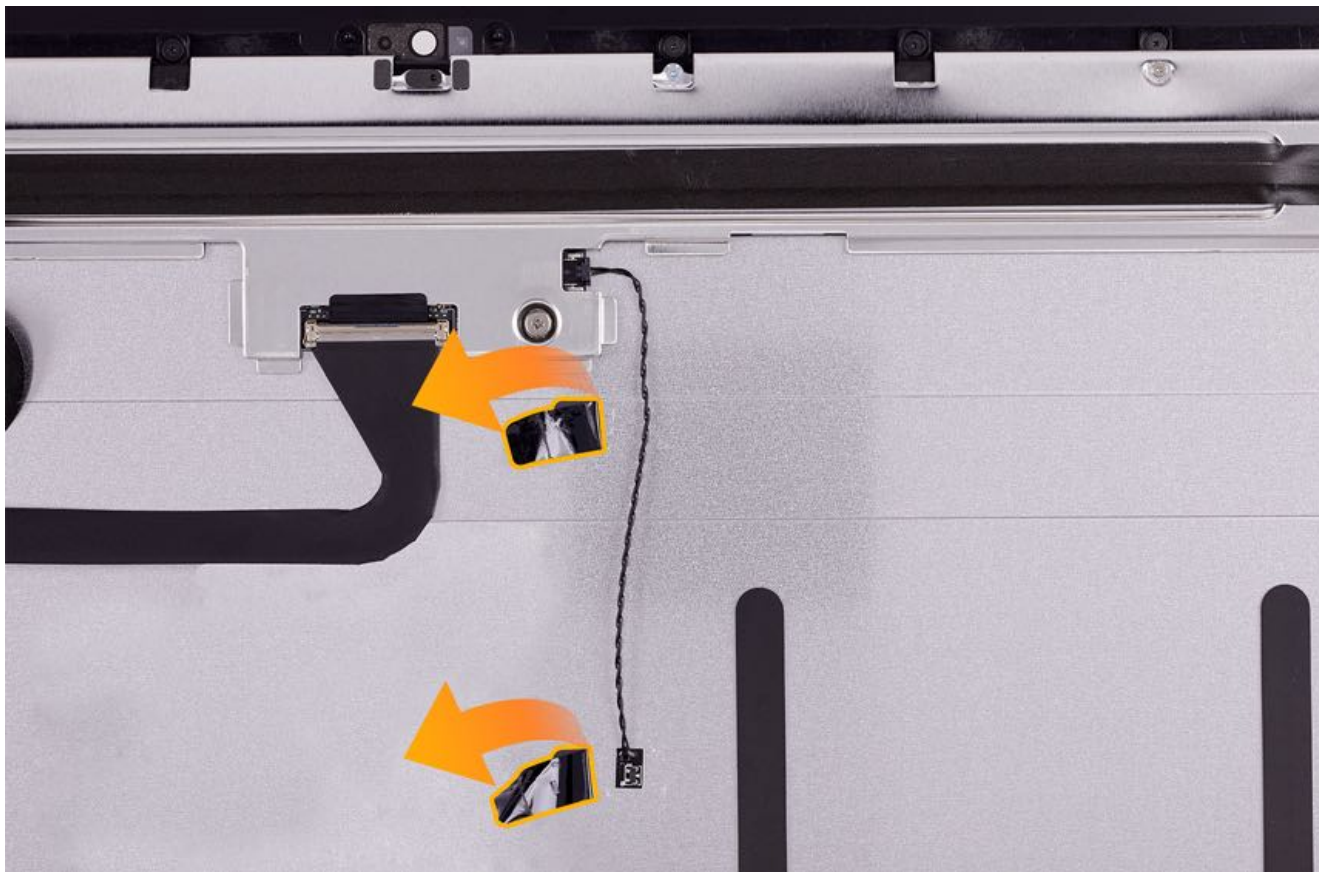
- Apple polishing cloth for nano-texture glass (923-04724)
- Gloves, anti-static and lint-free (922-8253)



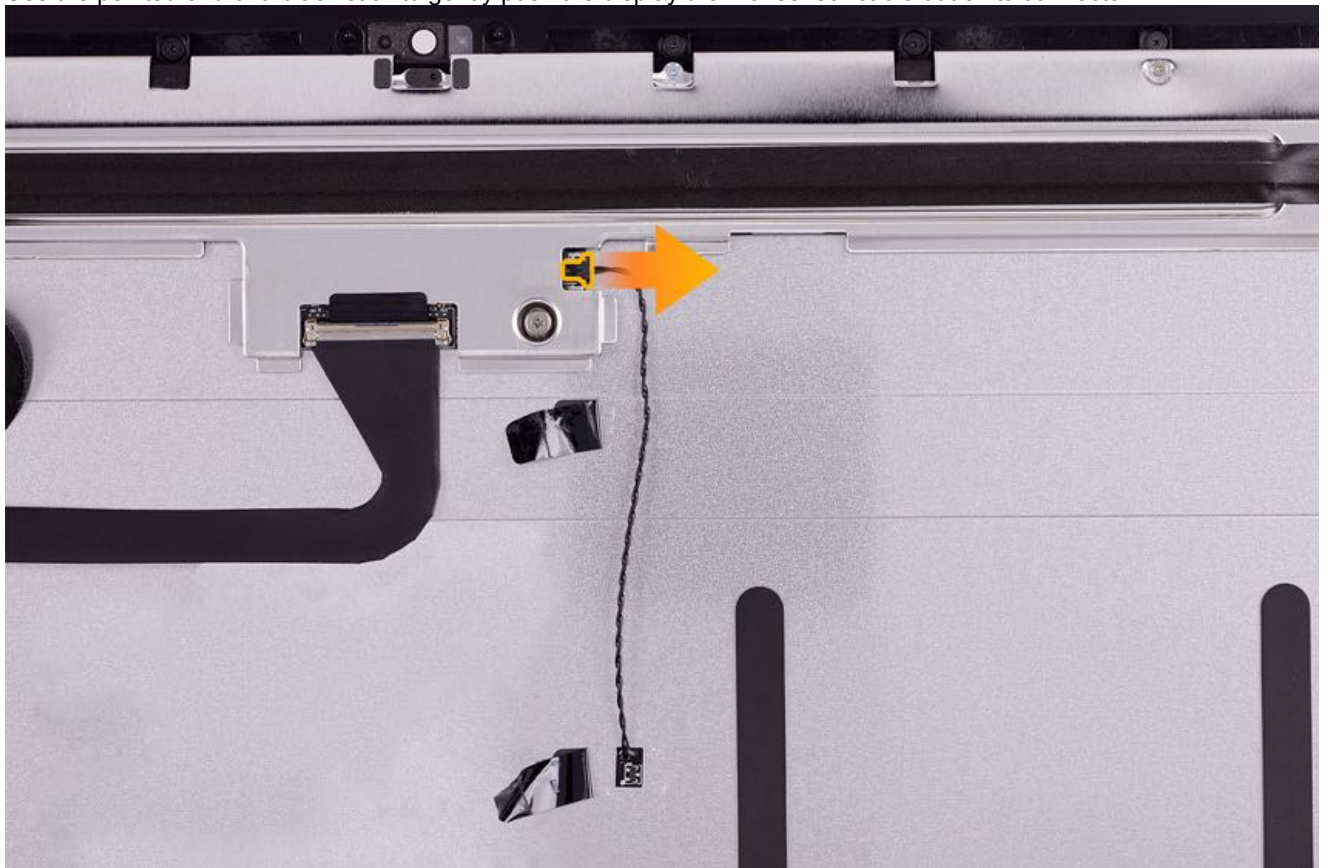
## Steps For Removal

1. Remove any tape that secures the display thermal sensor cable to the display panel.

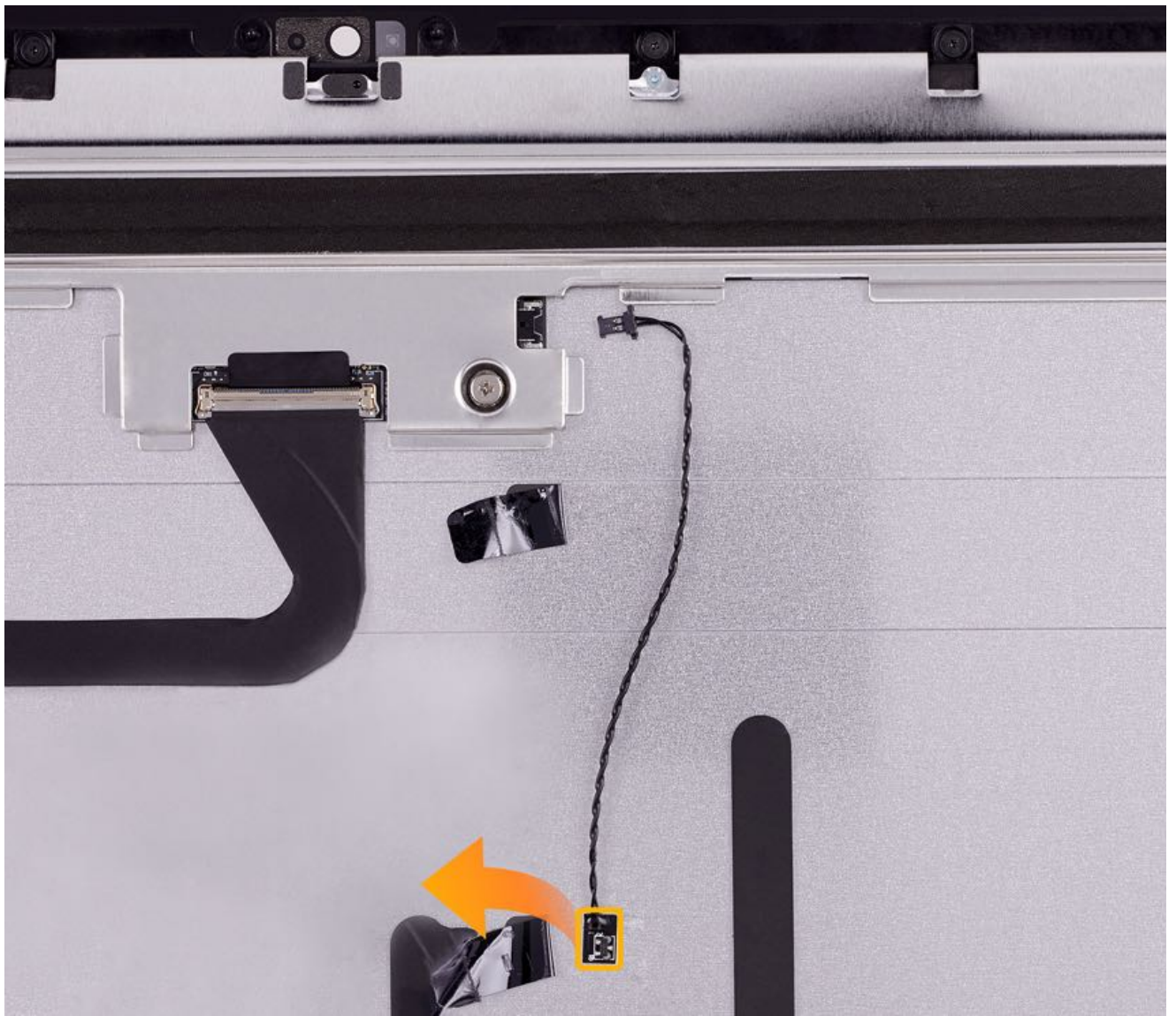




2. Use the pointed end of a black stick to gently push the display thermal sensor cable out of its connector.



3. Use a black stick to peel off the square sensor board from the display panel.

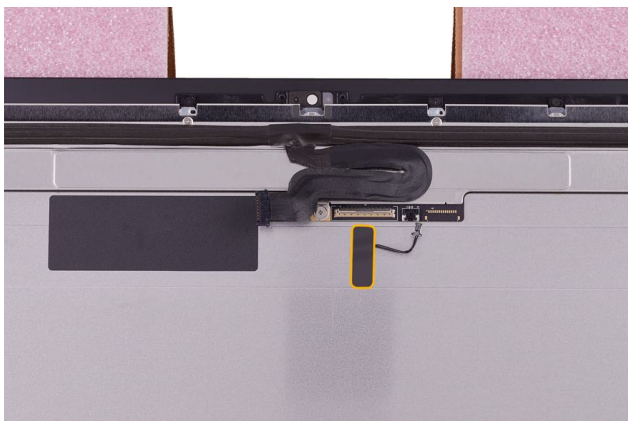


## Steps For Reassembly

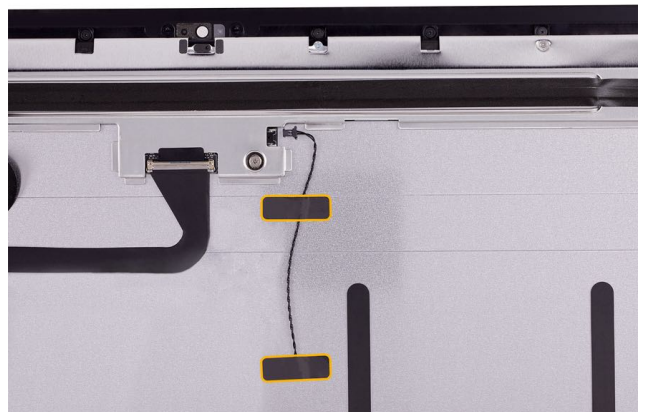
### Steps for Reassembly

1. Remove the adhesive backing from the replacement square sensor board and stick the adhesive side down on the display panel.
2. Secure the cable to the display panel with tape.

**iMac (Retina 4K, 21.5-inch, 2019)**

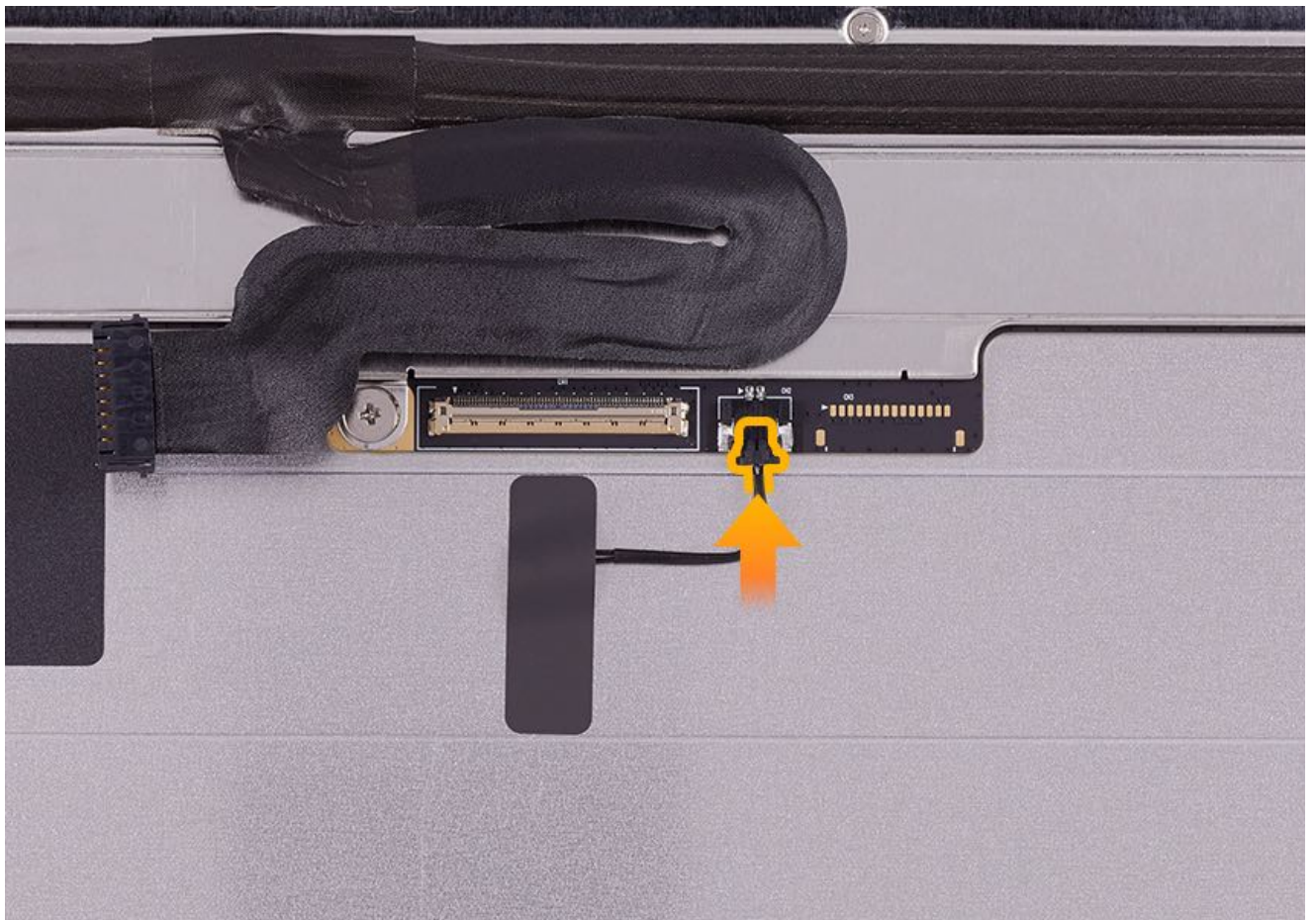


**iMac (Retina 5K, 27-inch, 2019 and 2020)**



3. Insert the cable into its connector.





4. Reinstall the display for the model you are repairing to complete reassembly:
  - [display reassembly](#) (2019)
  - [display reassembly](#) (2020)

# iMac (2019 and 2020) Embedded DisplayPort (eDP) Cable

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).
- Wear lint-free gloves (922-8253) when handling an iMac that has a nano-texture glass display. Use only the Apple polishing cloth (923-04724) to clean the nano-texture glass.

### Important:

- This procedure is shared between iMac (Retina 4K, 21.5-inch, 2019) iMac (Retina 5K, 27-inch, 2019) and iMac (Retina 5K, 27-inch, 2020). Images in this shared procedure may show one model, but the steps to perform the repair are the same for all.

### Remove:

- [Display removal](#) (2019)
- [Display removal](#) (2020)



## Tools

1. Black stick
2. iMac LCD service support stand (923-0416)

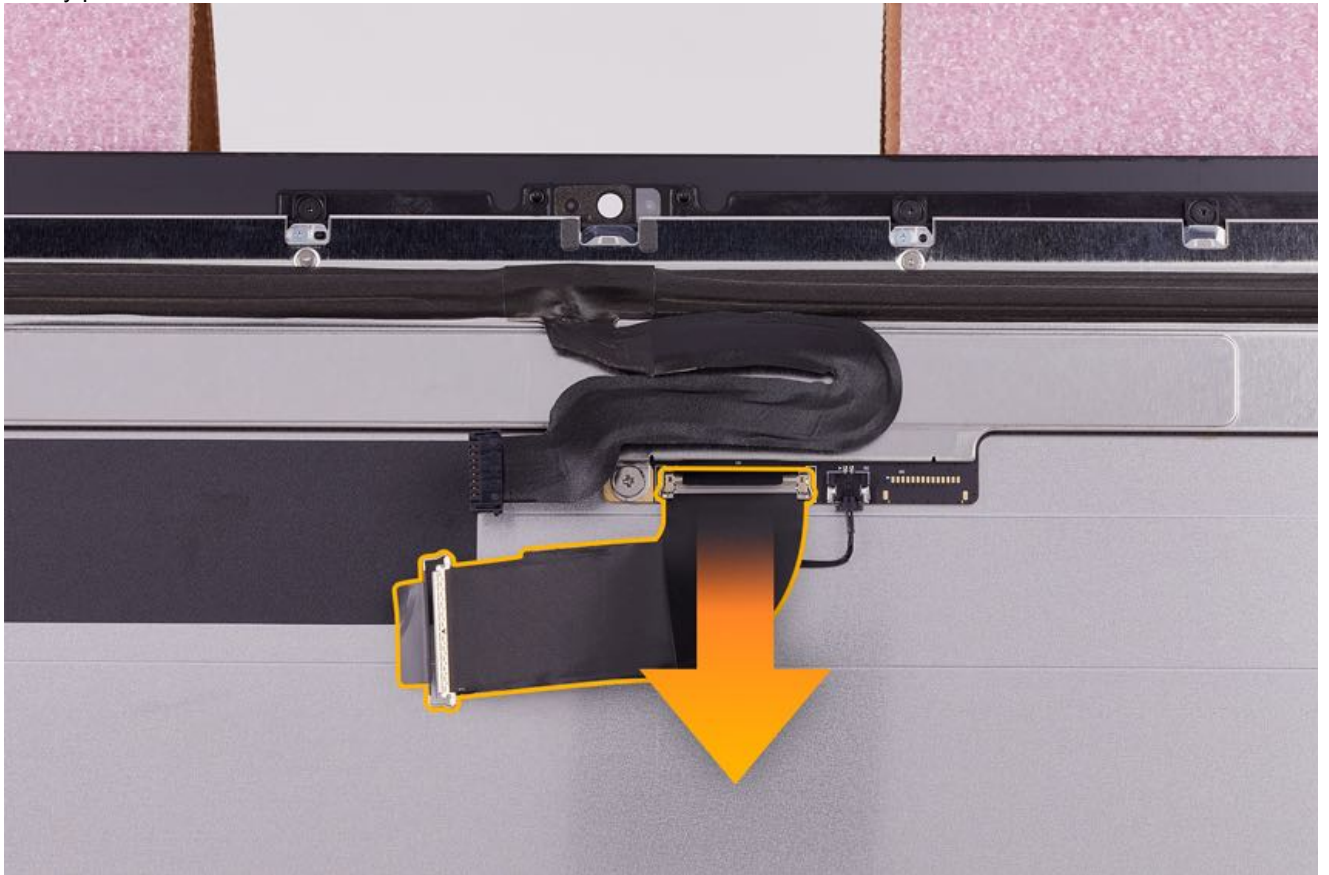
Required for displays with nano-texture glass. Not shown in image:

- Apple polishing cloth for nano-texture glass (923-04724)
- Gloves, anti-static and lint-free (922-8253)



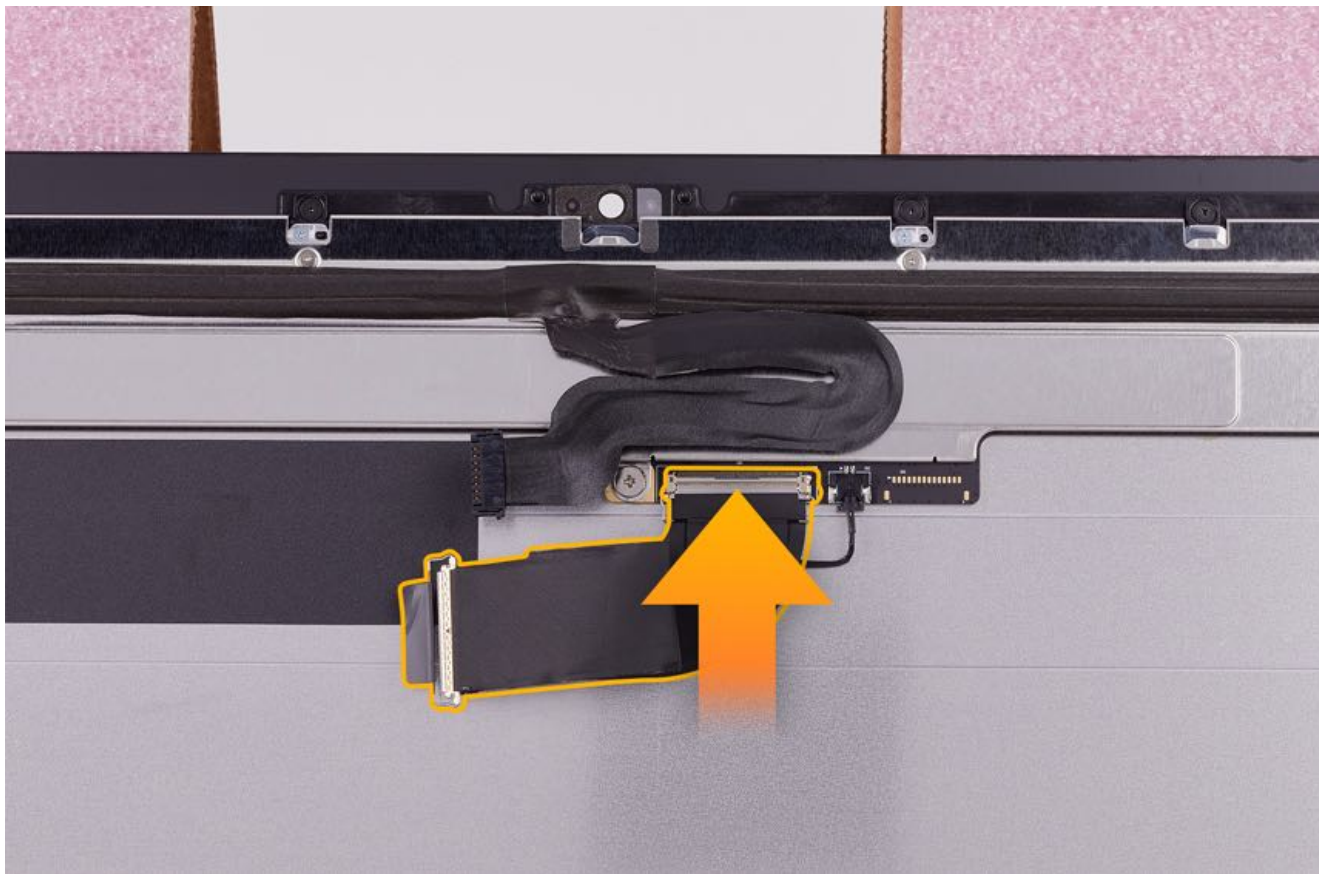
### Steps For Removal

1. Remove any tape from the eDP cable that was securing it to the display.
2. Use a black stick to lift the pull tab on the eDP cable.
3. Use your fingers to pull back the pull tab, which will unlock the lock bar.
4. Gently pull the eDP cable out of the connector.



### Steps For Reassembly

1. Insert the eDP cable into the connector on the display panel. Flip the lock bar down to secure the cable.



2. If any tape was present, reapply it to secure the cable to the display.
3. Reinstall the display for the model you are repairing to complete reassembly:
  - [display reassembly](#) (2019)
  - [display reassembly](#) (2020)



# iMac (Retina 5K, 27-inch, 2020) Fan

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- Some iMac (Retina 5K, 27-inch, 2020) models include a rear housing bracket installed next to the fan.
- There are two sets of removal and reassembly instructions. Follow the appropriate set of instructions for the model you are repairing:
  - Rear housing bracket included
  - Rear housing bracket not included

### Note:

- Images in this procedure may show the iMac (Retina 5K, 27-inch, 2019), but the steps to perform the repair are specific to iMac (Retina 5K, 27-inch, 2020).

### Remove:

- [Display](#)



## Tools

1. Black stick
  2. iMac service wedge
  3. Torx T10 screwdriver
- Torx T25 screwdriver (not shown, required for models with a rear housing bracket)





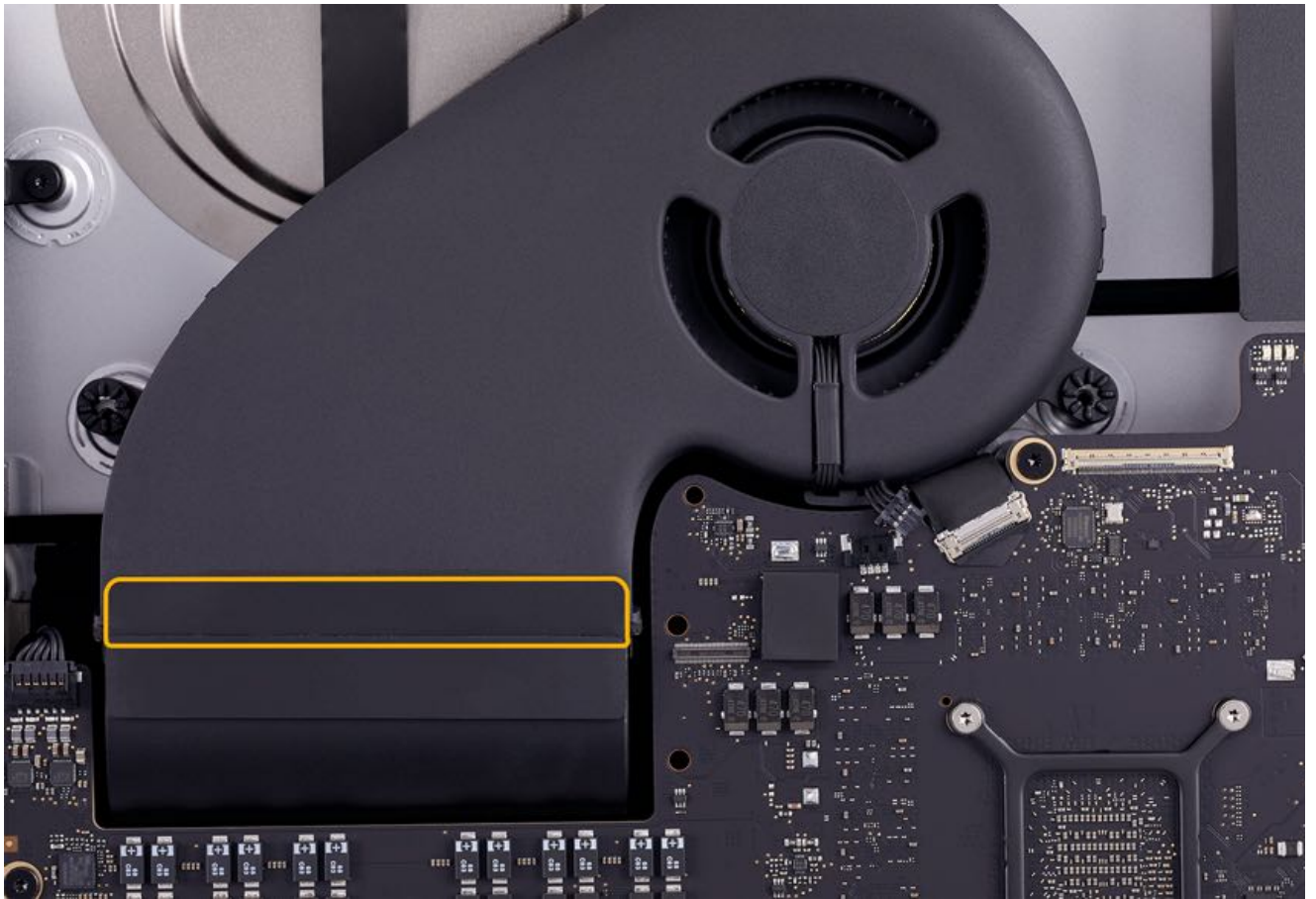
## Steps For Removal

Follow these removal steps if there is no rear housing bracket:

1. Use a black stick to disconnect the fan cable from the logic board. Then, remove three T10 screws from the fan.



2. Peel back the top edge of the black Mylar shield to loosen it from the fan. Remove the fan.



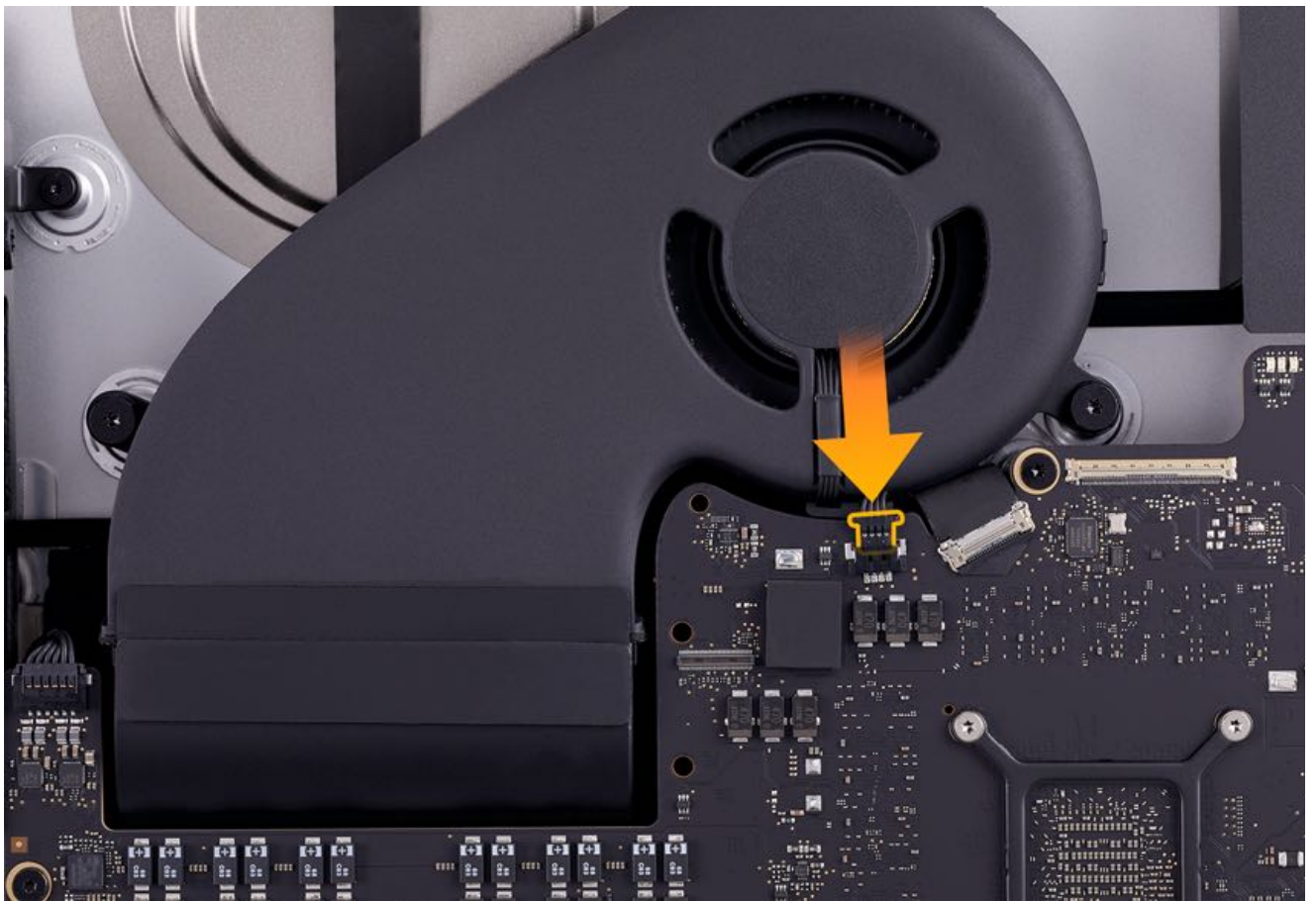
Follow these removal steps if a rear housing bracket is installed:

1. Use a black stick to disconnect the fan cable from the logic board.
2. Remove two T10 screws, one on the top and one on the right side of the fan.
3. Remove one T10 screw from the rear housing bracket, on the left side of the fan.
4. Rotate the rear housing bracket to the left, then remove one T25 superscrew.
5. Peel back the top edge of the black Mylar shield to loosen it from the fan, then remove the fan from the rear housing.

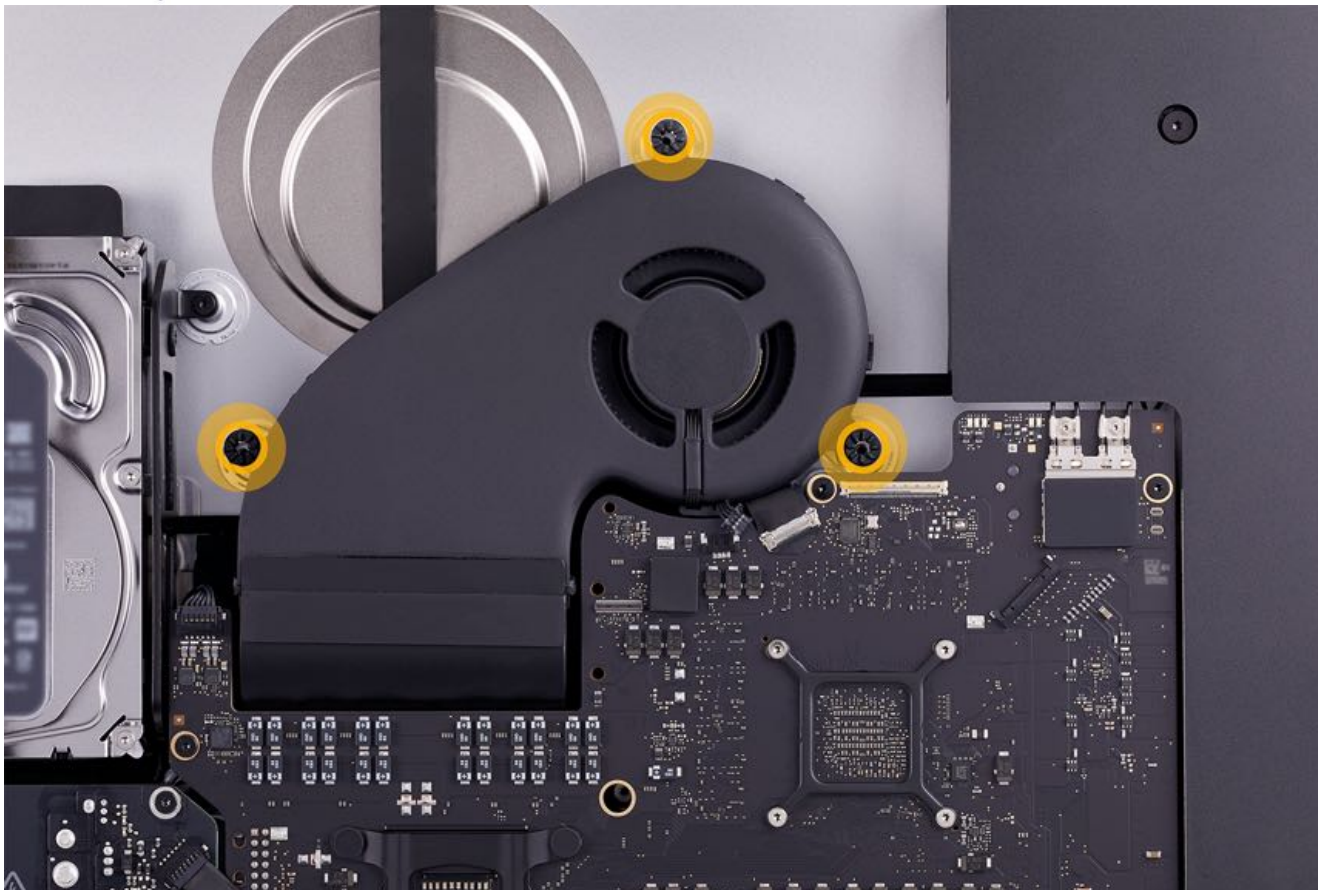
## Steps For Reassembly

Follow these reassembly steps if there is no rear housing bracket:

1. Connect the fan cable to the logic board.



2. Reinstall three T10 screws (923-00669) in the fan.



3. Reinstall the [display](#) to complete reassembly.

Follow these reassembly steps if a rear housing bracket is installed:

1. Install the fan in the rear housing. Press the Mylar shield to the front of the fan.
2. Connect the fan cable to the logic board.
3. Reinstall one T25 superscrew (923-03311) in the left screw hole of the fan. Then, rotate the rear housing bracket to the right, over the superscrew.
4. Align the screw hole in the rear housing bracket with the superscrew below, then reinstall one T10 screw (923-03434) in the rear housing bracket.
5. Reinstall the two remaining T10 screws (923-00669).
6. Reinstall the [display](#) to complete reassembly.



# iMac (Retina 5K, 27-inch, 2019 and 2020) Left Speaker

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- Speakers must be replaced in pairs. If you replace the left speaker, then you must also replace the [right speaker](#).

### Note:

- Images in this procedure show the iMac (Retina 5K, 27-inch, 2019). Unless noted, the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- [Display removal](#) (2019)
- [Display removal](#) (2020)



## Tools

1. Black stick
2. Phillips #00 screwdriver
3. Torx T10 screwdriver
4. iMac service wedge
5. Sticky notes (2019 only)



## Steps For Removal

1. Remove nine Phillips #00 screws from the chin.



2. Remove the chin strap by threading the pointed end of a black stick or tweezers through one of the black air loops, then lift the chin strap out. Set aside for reuse.

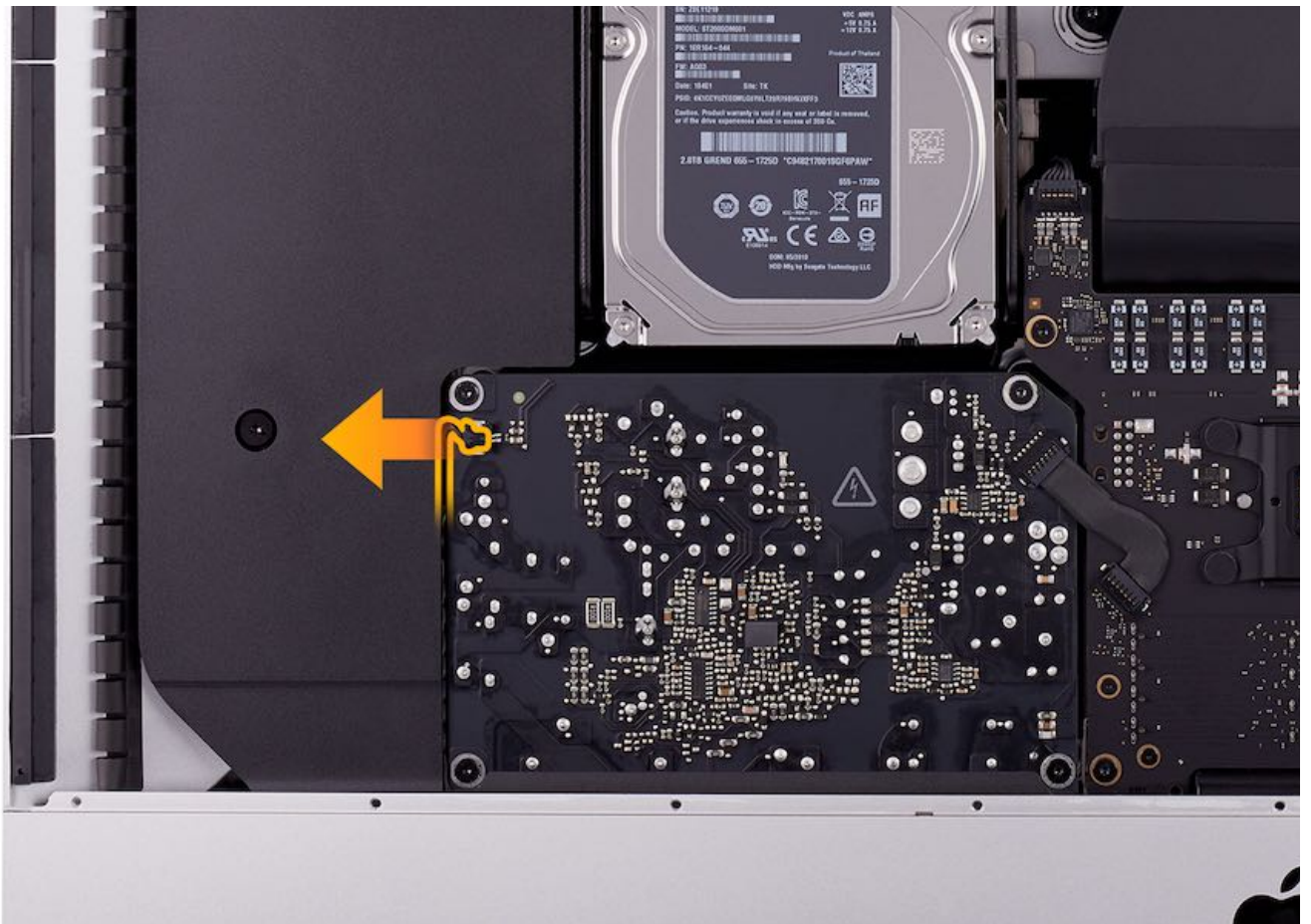


**Caution:** Be careful not to bend the chin strap.



3. Disconnect the power button cable from the power supply.  
**Caution:** The power button cable is part of the rear housing. If the cable breaks, the rear housing will need to be replaced.





4. Completely unscrew two T10 screws from the speaker.

**Note:** The screws tighten into rubber grommets and may remain in the screw holes when the speaker is removed.



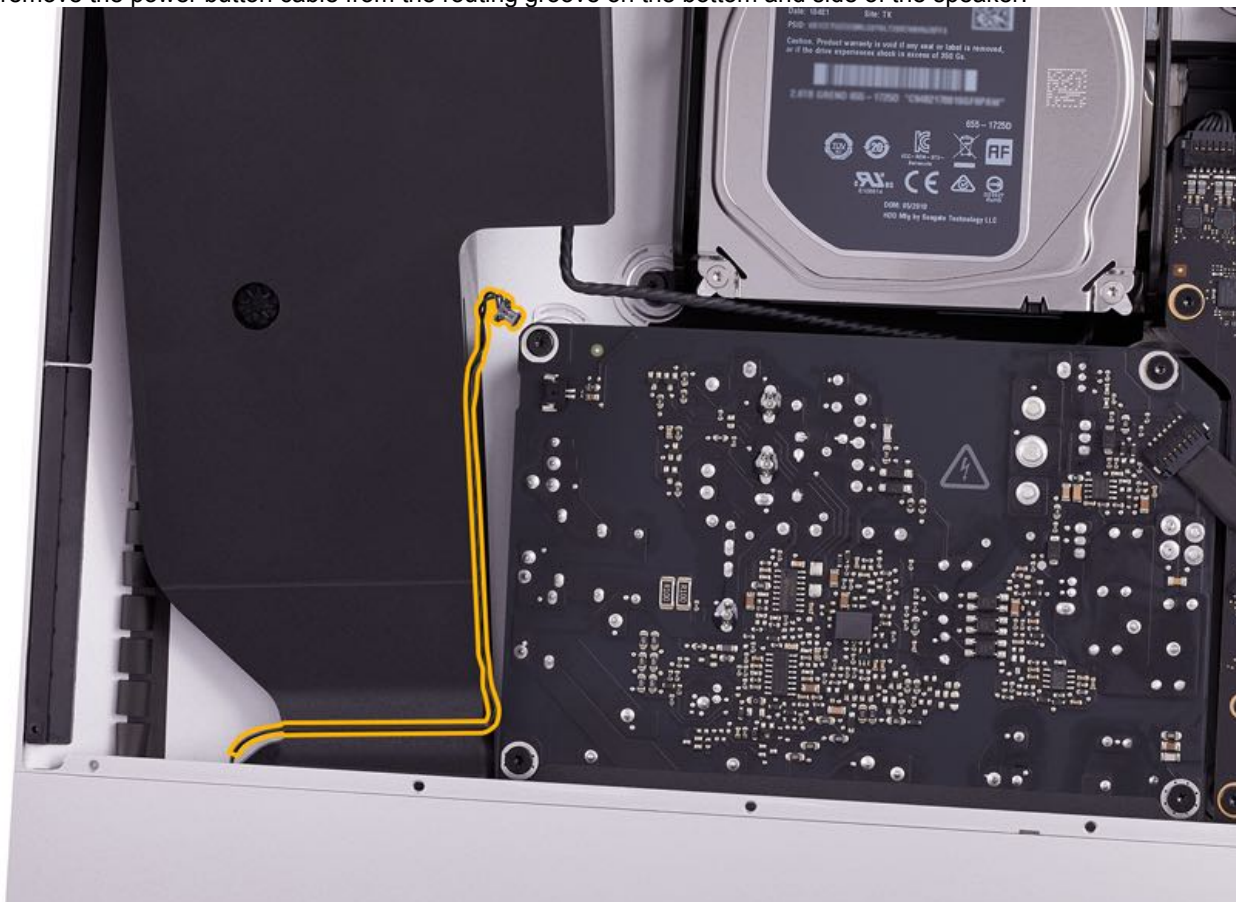
**Caution:** The power button cable is routed in a groove on the speaker. Use care when handling the speaker to avoid damaging the power button cable. If the cable breaks, the rear housing will need to be replaced.

5. Tilt the speaker slightly forward (1) then lift (2) until the power button cable is visible.

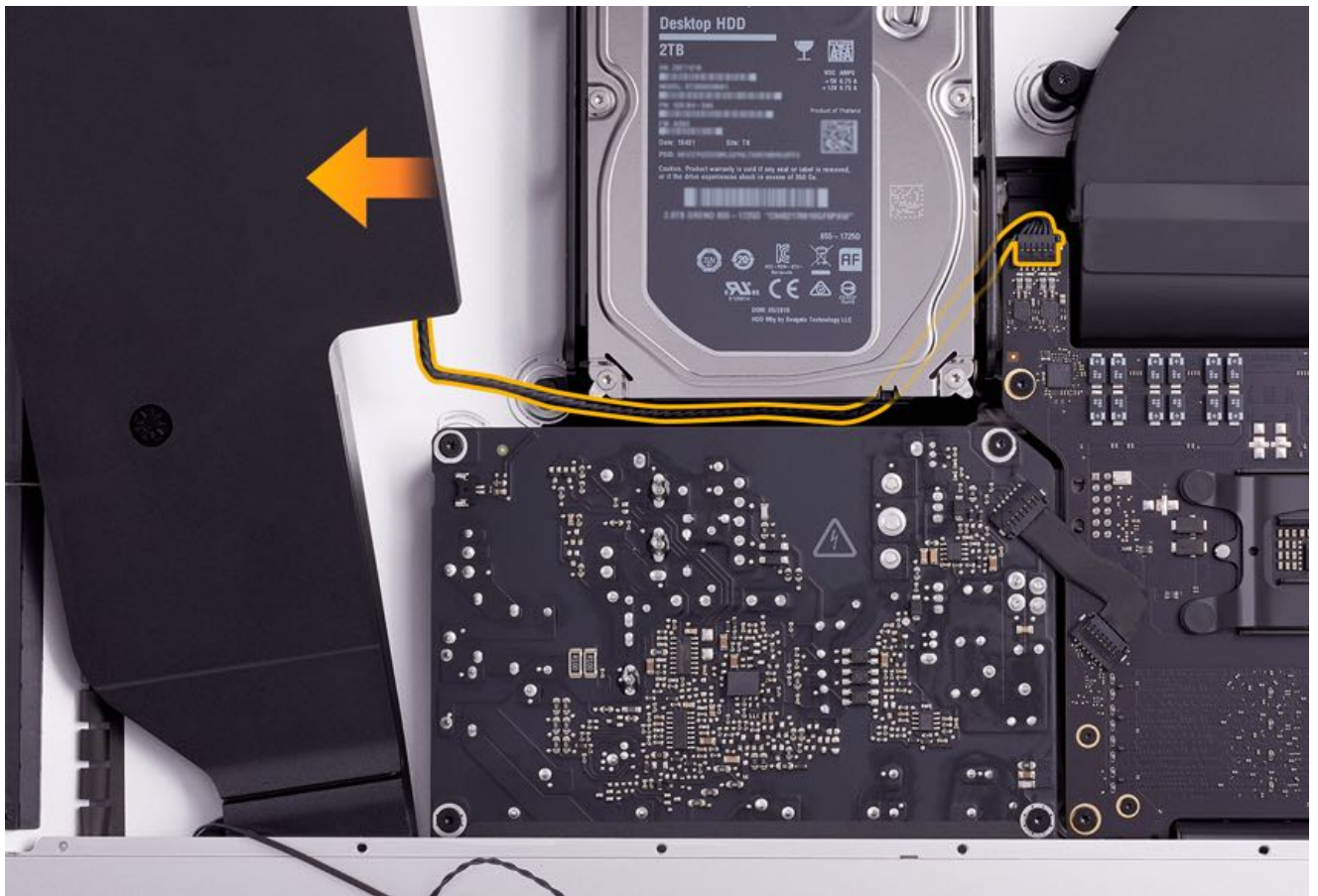




6. Gently remove the power button cable from the routing groove on the bottom and side of the speaker.



7. Tilt the speaker to the left. Disconnect the speaker cable from the logic board. Lift the speaker out of the rear housing.  
**Note:** For 2019 iMac only, gently pull the speaker cable from under the hard drive and the right hard drive bracket.



## Steps For Reassembly

1. For the 2020 model, skip to step #4.
2. Support the hard drive with one hand. Remove two T8 screws from the left hard drive mounting bracket. Remove the bracket.



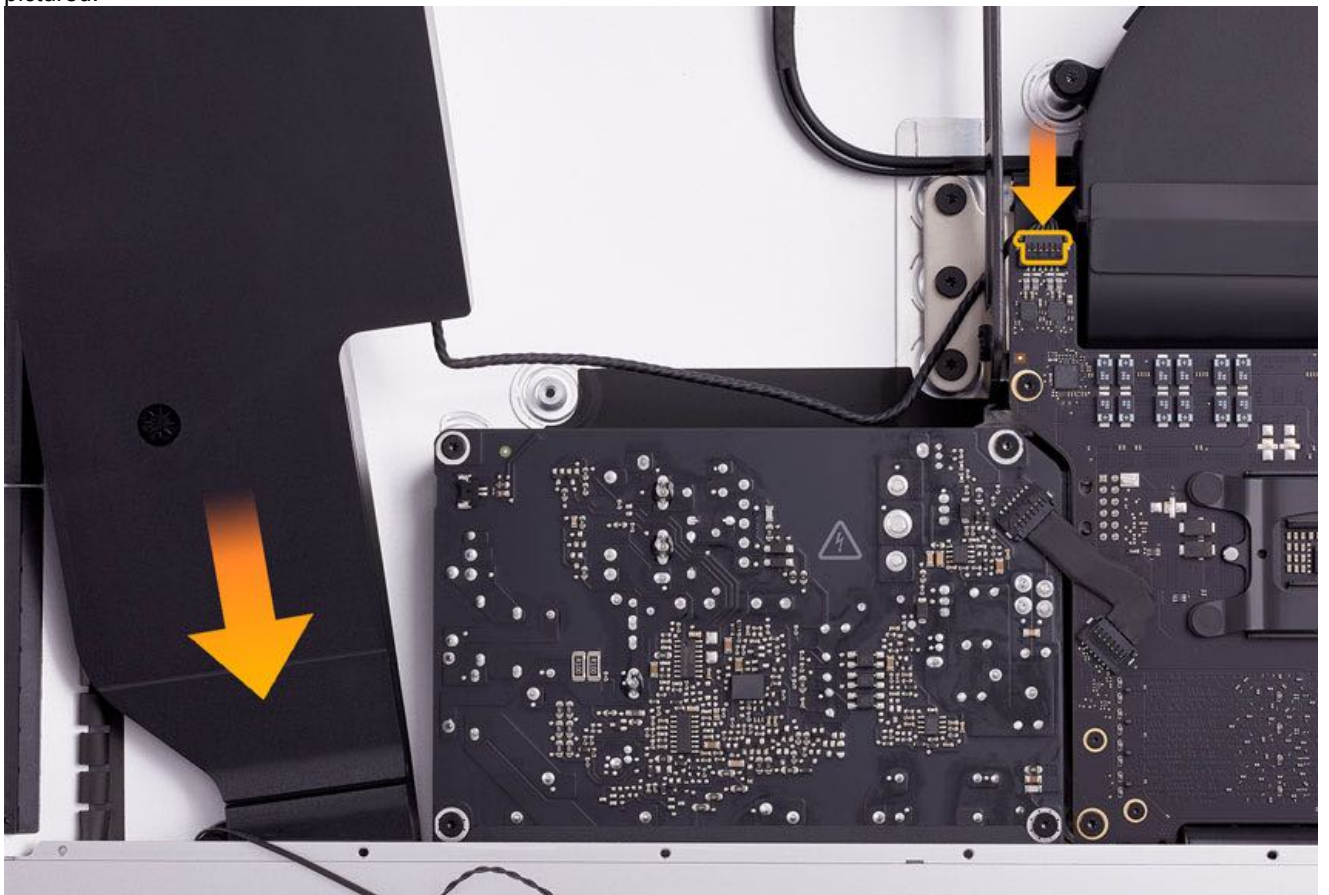
3. Disconnect the data and power cable from the top of the hard drive. Slide the hard drive out of the right mounting bracket. Remove the hard drive.





4. Position the speaker in the rear housing. Route the speaker cable along the top edge of the power supply. Connect the speaker cable to the logic board.

Note: For the 2019 model only, ensure that the speaker cable is routed under the right hard drive mounting bracket as pictured.



5. Route the power button cable in the groove on the bottom and side of the speaker.  
**Important:** Ensure that the power button cable does not bind or slip out of the routing groove as you place the speaker into the rear housing.



6. For the 2020 model, skip to step #9.
7. Reconnect the hard drive data and power cable to the hard drive. The cable should lay flat under the hard drive. Align the hard drive mounting pins with the rubber grommets on the right mounting bracket.



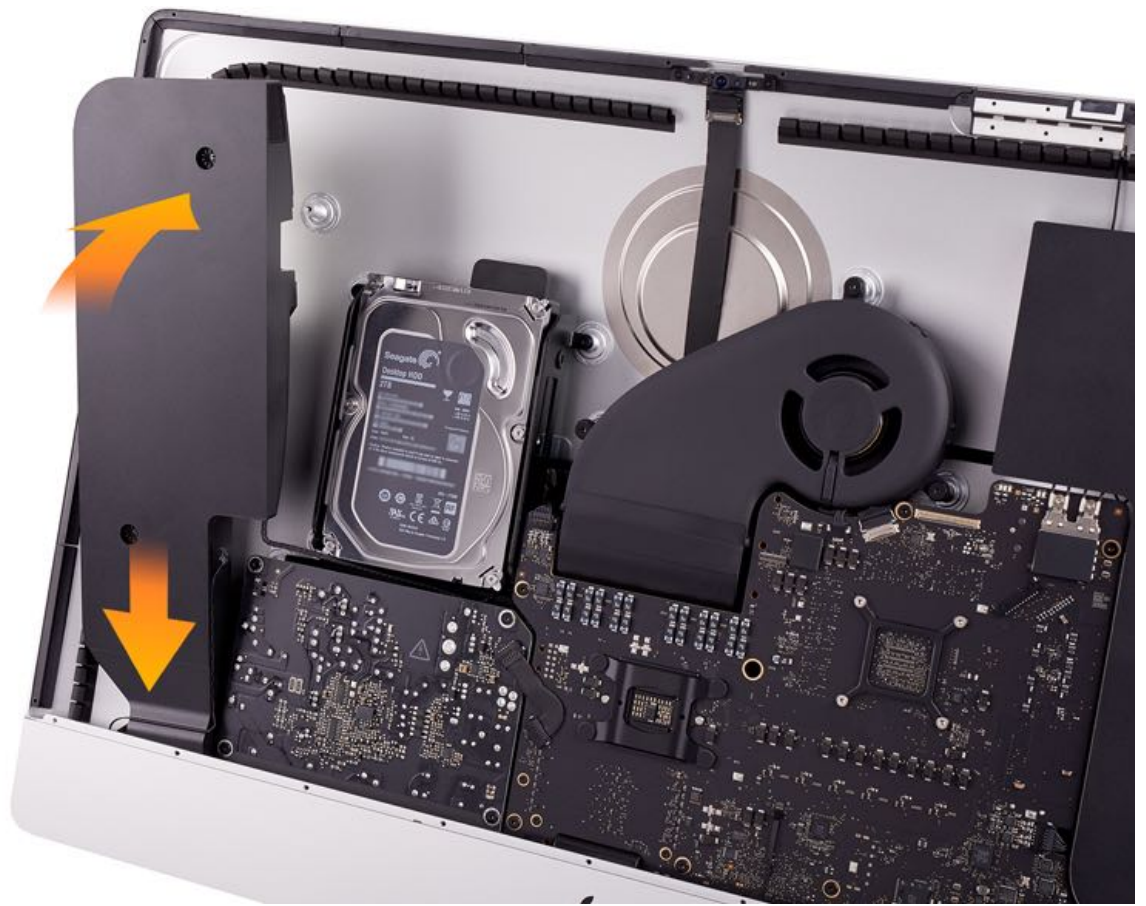


8. Reinstall the left mounting bracket and two T8 (923-0331) screws.



9. Lower the speaker the rest of the way into the chin, then position it in the rear housing.





10. Reinstall the two T10 (923-0333) screws in the speaker. For the 2019 model only, do not fully tighten the screws at this point.

**Note:** For the 2020 model, skip to step #12.



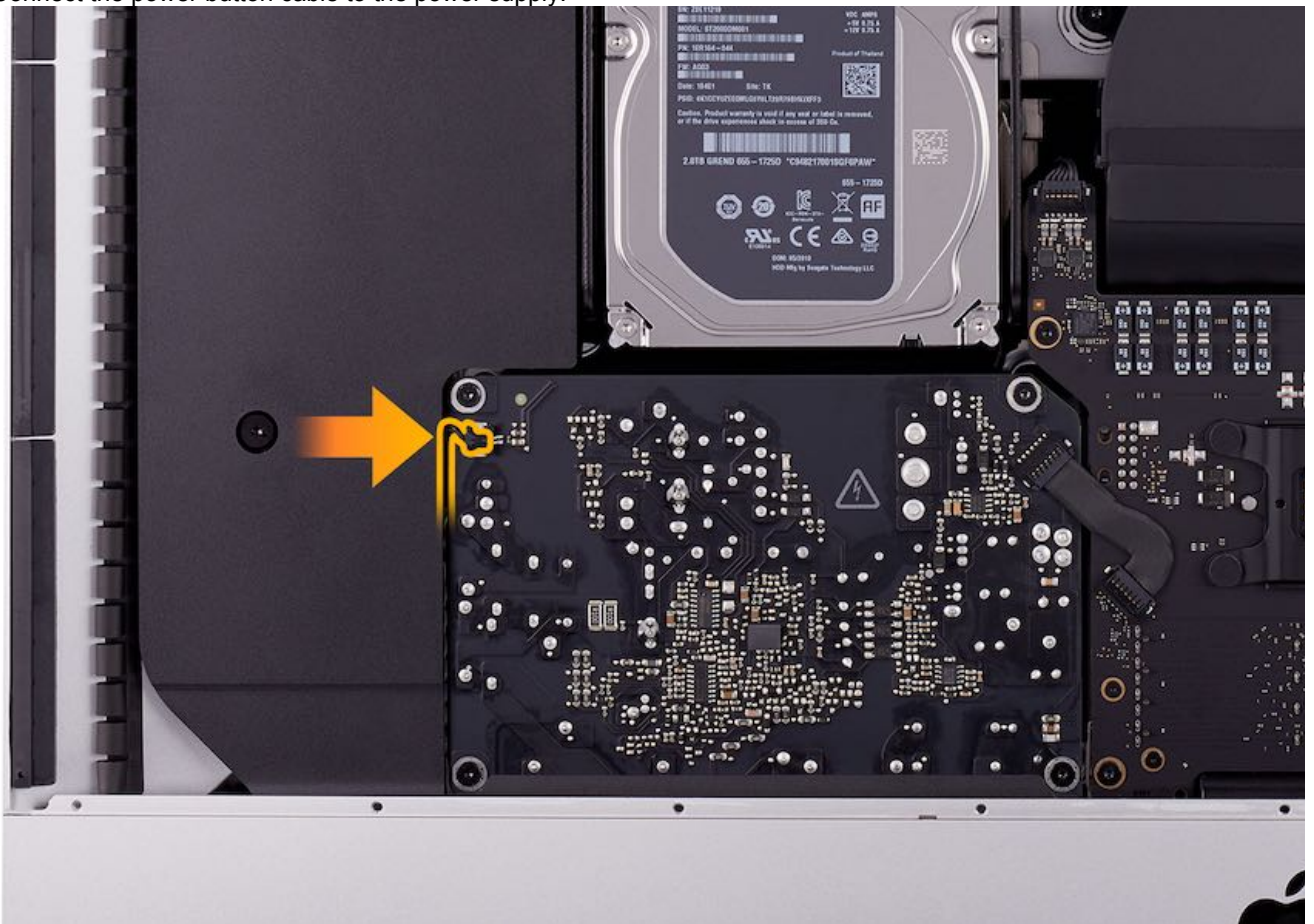


11. Correct spacing between the left speaker and hard drive requires inserting a 1.85 mm shim between the left speaker and left hard drive mounting bracket. Stack 18 individual sticky notes to make a 1.85 mm shim. Insert the shim between the speaker and left bracket. Tighten the T10 speaker screws after inserting the shim.





12. Connect the power button cable to the power supply.



13. Thread the pointed end of a black stick or tweezers through one of the air loops in the middle of the chin strap. Use the black stick or tweezers to insert the chin strap into the rear housing and position it such that the metal screw holes face the inside edge of the chin. The air loops on the chin strap should be facing up.

14. Use a black stick to press the chin strap against the front frame, if needed.



15. Reinstall the nine Phillips #00 (923-0338) screws in the chin strap.





16. Reinstall the display for the model you are repairing to complete reassembly:
- [display reassembly](#) (2019)
  - [display reassembly](#) (2020)



# iMac (Retina 5K, 27-inch, 2019 and 2020) Right Speaker

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- Speakers must be replaced in pairs. If you replace the right speaker, then you must also replace the [left speaker](#).

### Note:

- Images in this procedure show the iMac (Retina 5K, 27-inch, 2019), but the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- [Display removal](#) (2019)
- [Display removal](#) (2020)



## Tools

1. Black stick
2. iMac service wedge
3. Torx T10 screwdriver
4. Phillips #00 screwdriver



## Steps For Removal

1. Remove nine Phillips #00 screws from the chin.



2. Remove the chin strap by threading the pointed end of a black stick or tweezers through one of the black air loops, then lift the chin strap out. Set aside for reuse.



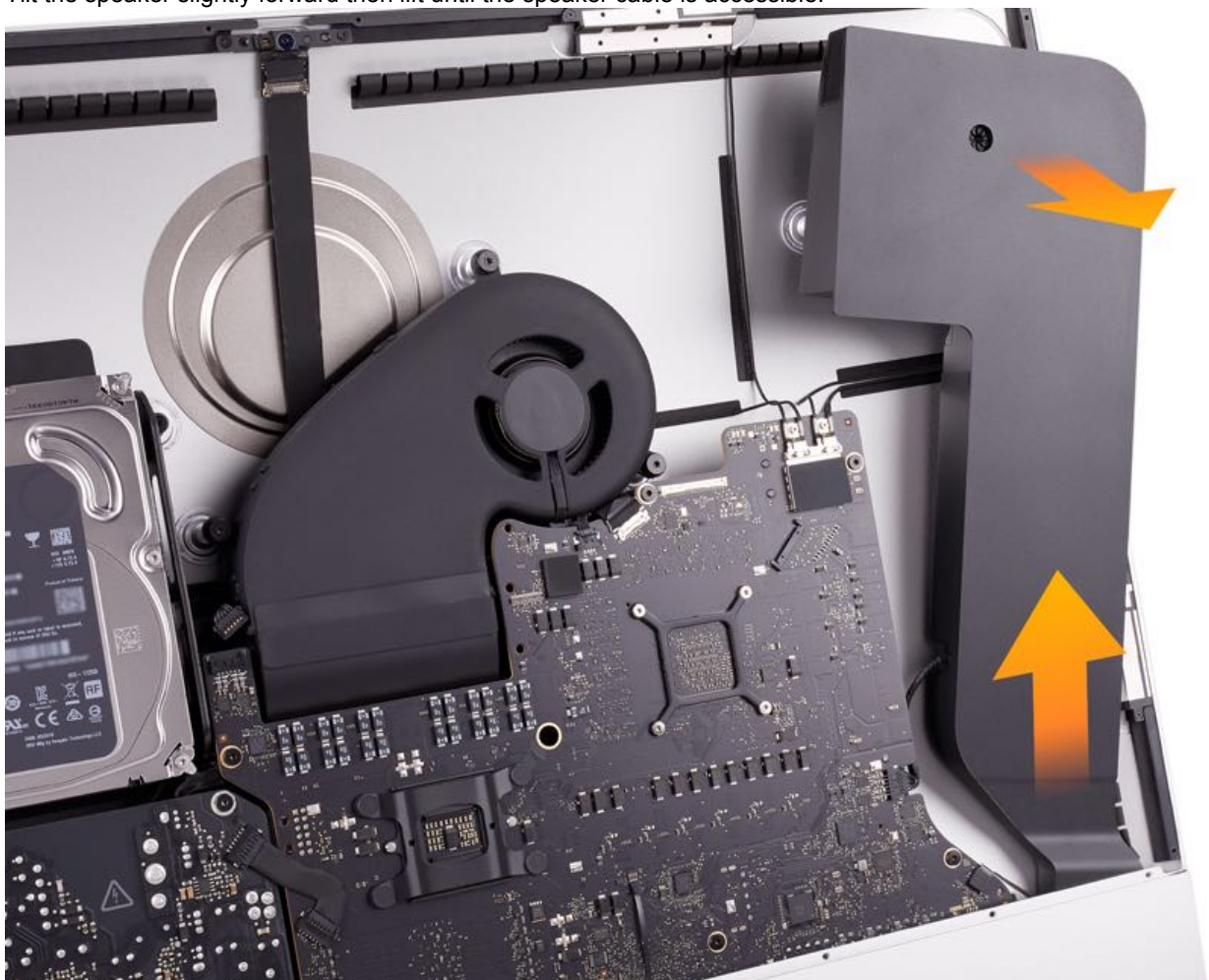


**Caution:** Be careful not to bend the chin strap.

3. Completely unscrew two T10 screws from the speaker.  
**Note:** The screws tighten into rubber grommets and may remain in the screw holes when the speaker is removed.

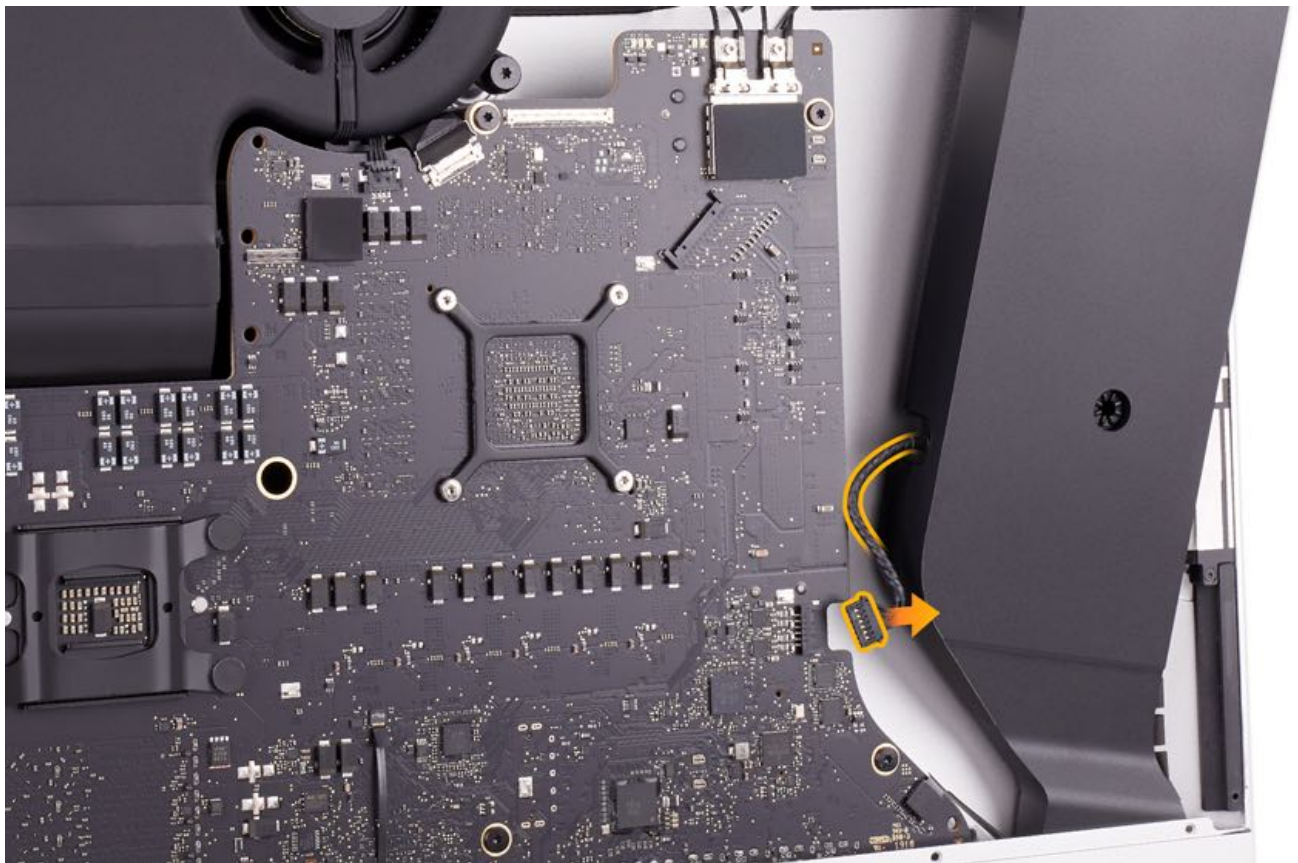


4. Tilt the speaker slightly forward then lift until the speaker cable is accessible.



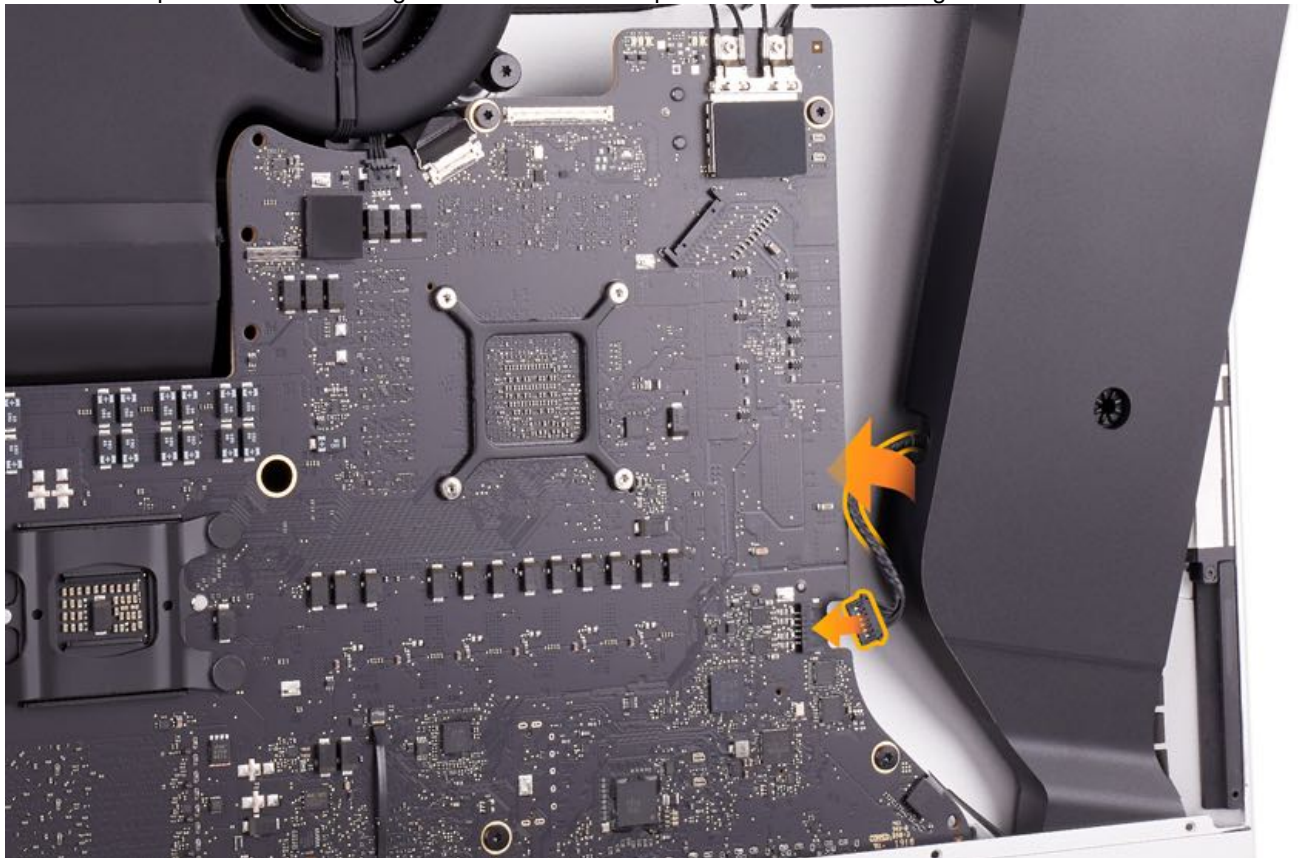
5. Disconnect the speaker cable from the logic board and lift the speaker out of the rear housing.





### Steps For Reassembly

1. Partially insert the speaker in the rear housing.
2. Connect the speaker cable to the logic board and tuck the speaker cable under the logic board.



3. Reinstall the two T10 (923-0333) speaker screws.  
**Caution:** Ensure that the speaker sits down inside the rear housing as far as possible. If the speaker is not positioned correctly in the rear housing, it can cause display interference issues.



4. Thread the pointed end of a black stick or tweezers through one of the air loops in the middle of the chin strap. Use the black stick or tweezers to insert the chin strap into the rear housing and position it such that the metal screw holes face the inside edge of the chin. The air loops on the chin strap should be facing up.



5. Use a black stick to press the chin strap against the front frame, if needed.



6. Reinstall the nine Phillips #00 (923-0338) screws in the chin strap.







7. Reinstall the display for the model you are repairing to complete reassembly:
- [display reassembly](#) (2019)
  - [display reassembly](#) (2020)



# iMac (Retina 5K, 27-inch, 2019 and 2020) Power Supply

## First Steps



### Warning! Electrical Shock Hazard:

- Never plug the computer in to an electrical outlet during a repair procedure.
  - The power supply and logic board remain powered when the computer is plugged in whether or not the computer has been turned on.
  - After unplugging the computer from the electrical outlet, wait two minutes for the power supply and logic board to discharge before removing the display, disconnecting modules, or substituting cables and components.
  - Do not perform any troubleshooting until [protective covers](#) (TP833) have been installed over the power supply and logic board.
  - You must follow additional [safety precautions](#) (TP820) when performing troubleshooting that requires you to operate the computer when it is plugged into an electrical outlet and the display is removed.
- 

### Caution:

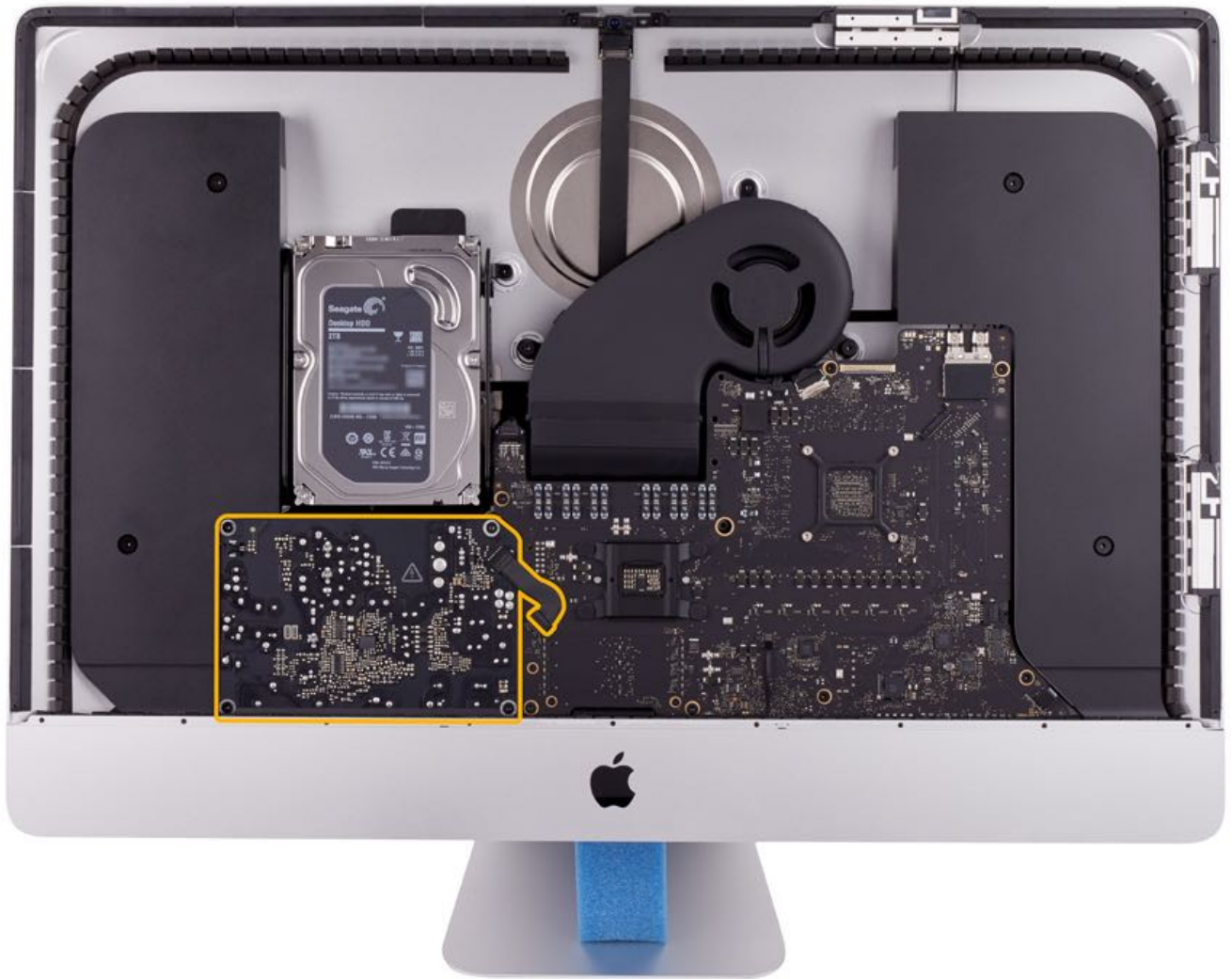
- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Note:

- Images in this procedure show the iMac (Retina 5K, 27-inch, 2019), but the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- Display
  - [Display removal](#) (2019)
  - [Display removal](#) (2020)
- [Left speaker](#)
- [Hard drive](#) (2019 only)



## Tools

1. Black stick
2. iMac service wedge
3. Torx T8 screwdriver



## Steps For Removal



**Warning! Electrical Shock Hazard:** Verify the computer is unplugged from the electrical outlet. If the computer is plugged in to an electrical outlet, unplug it, then wait two minutes for the power supply and logic board to discharge before continuing.

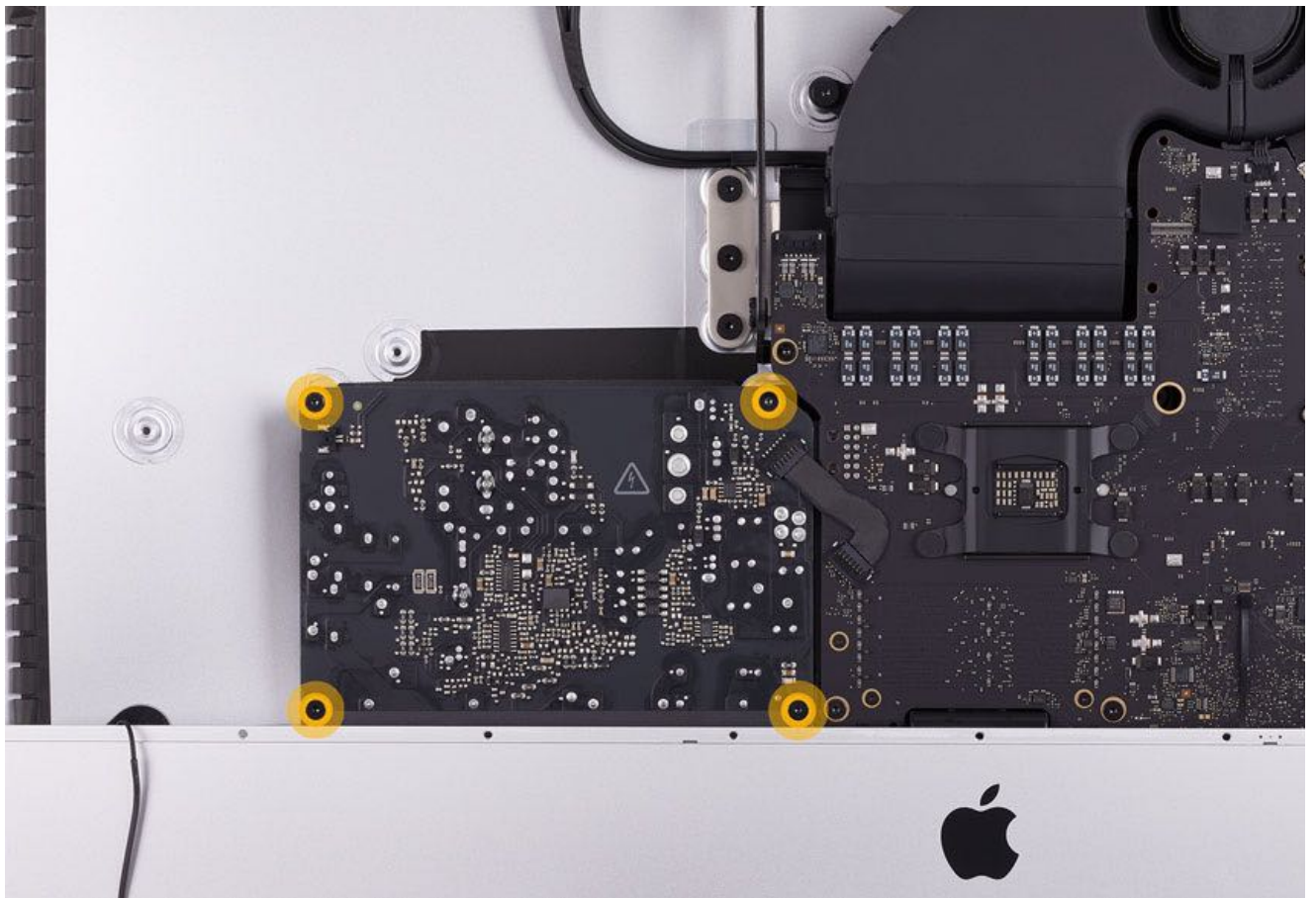


1. Disconnect the power signal cable from the power supply and logic board.

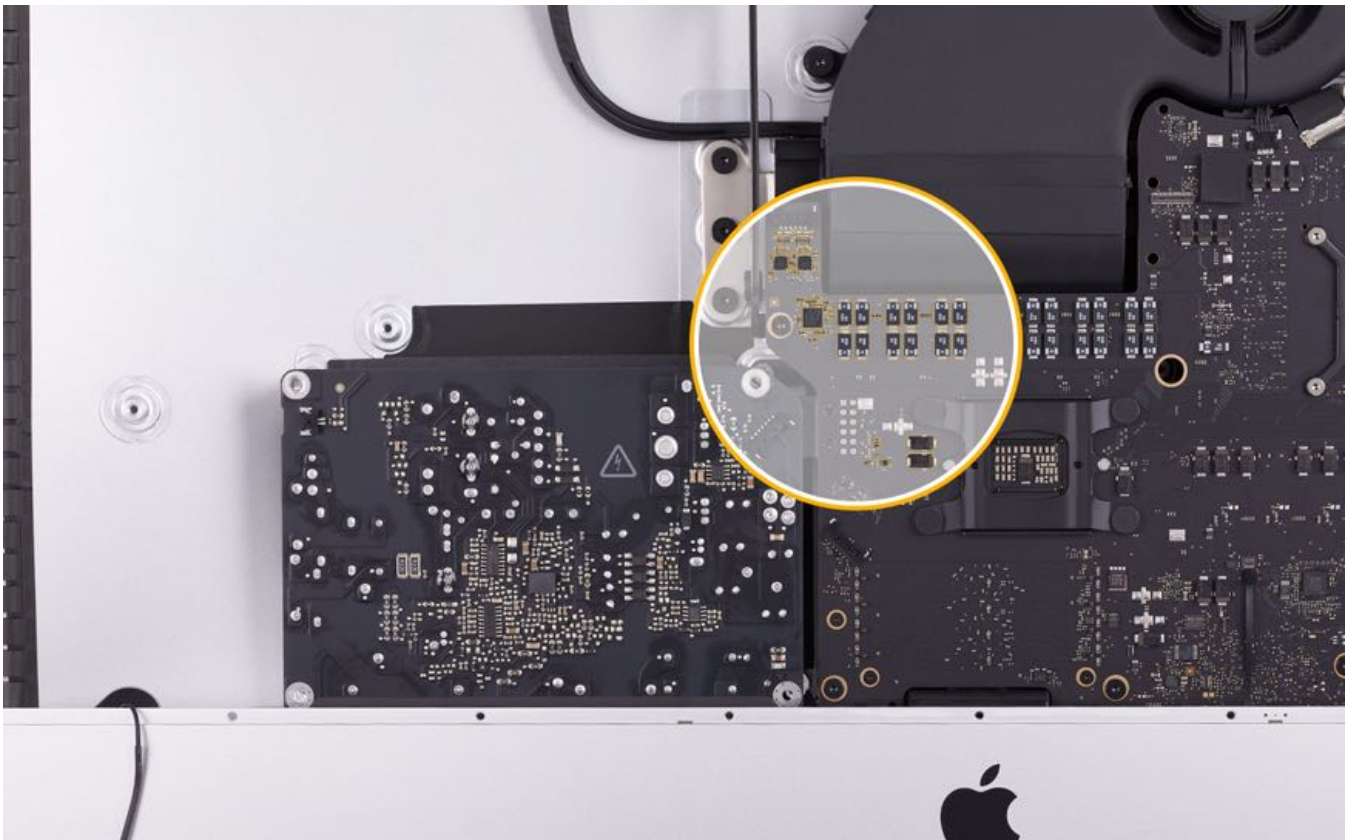


2. Remove four T8 screws from the power supply.





**Caution:** When performing step 3, don't rotate the power supply toward the logic board as it could damage parts of the logic board.

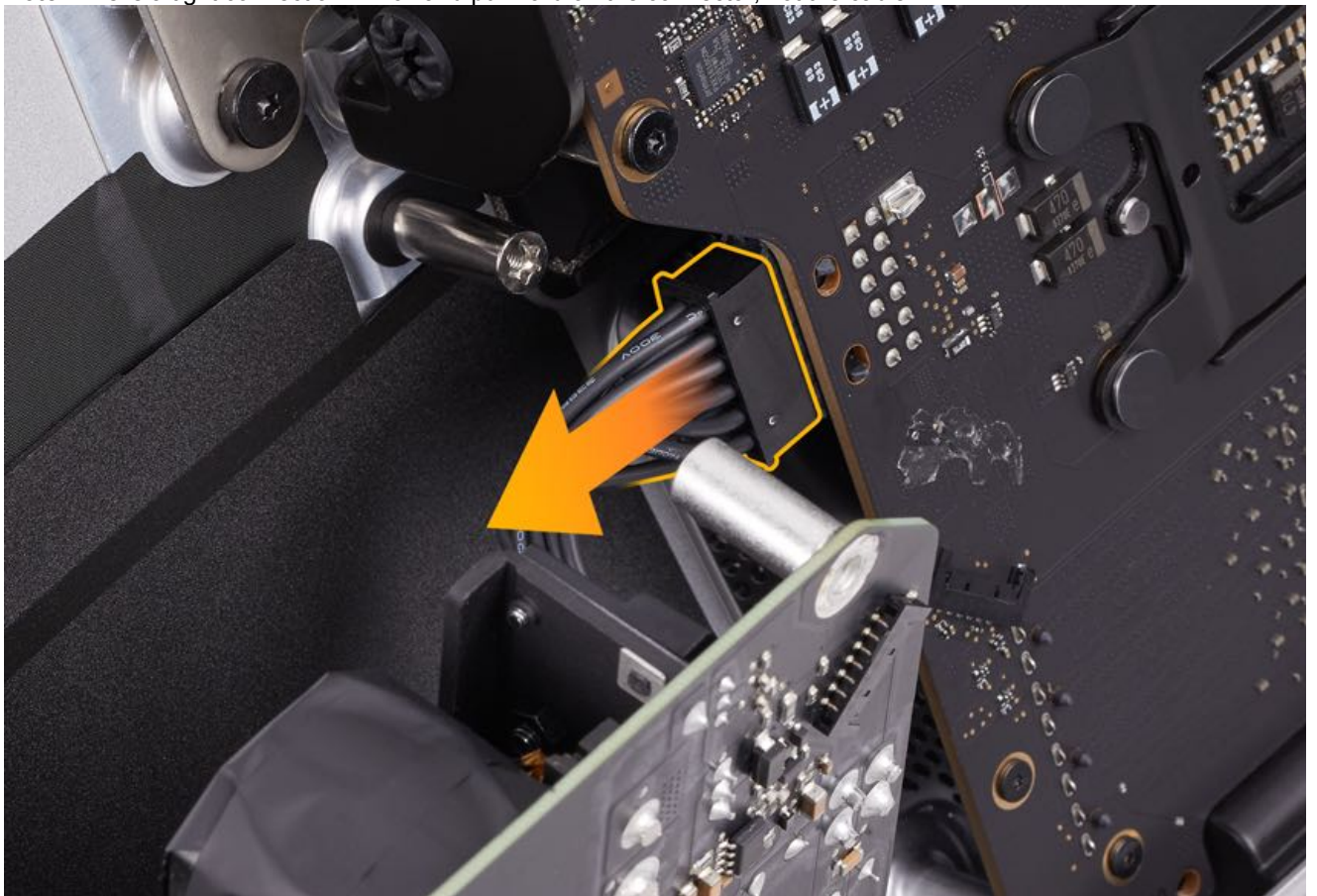


3. Slide the power supply slightly to the left (1), then tilt the power supply slightly forward (2).



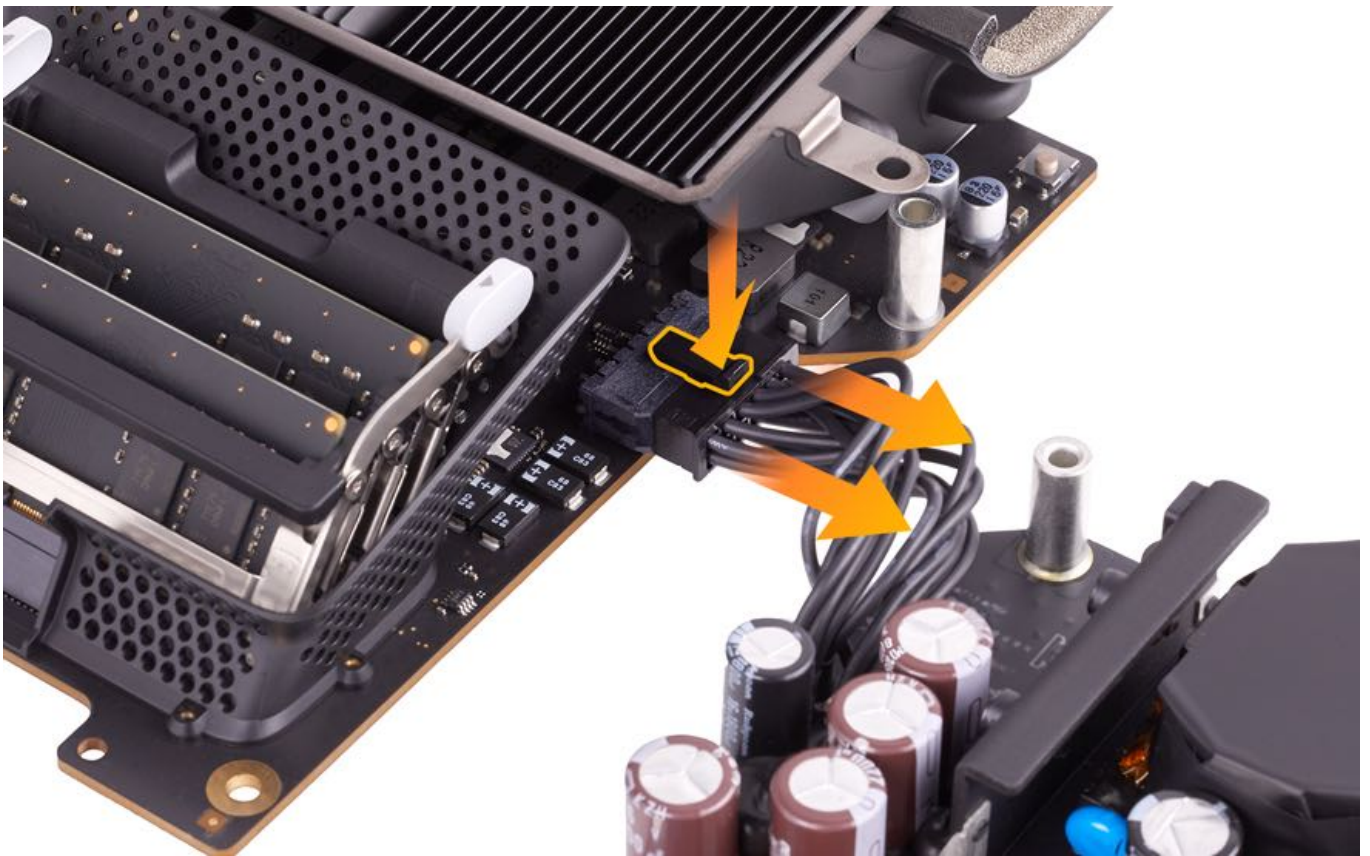
4. Pinch the clip on the rear side of the DC cable connector and pull to disconnect the cable.

**Note:** This is a tight connection. Pinch and pull hard on the connector, not the cable.



**Important:** To better understand what you are disconnecting in the previous step, the image below shows the clip on the rear side of the DC cable.





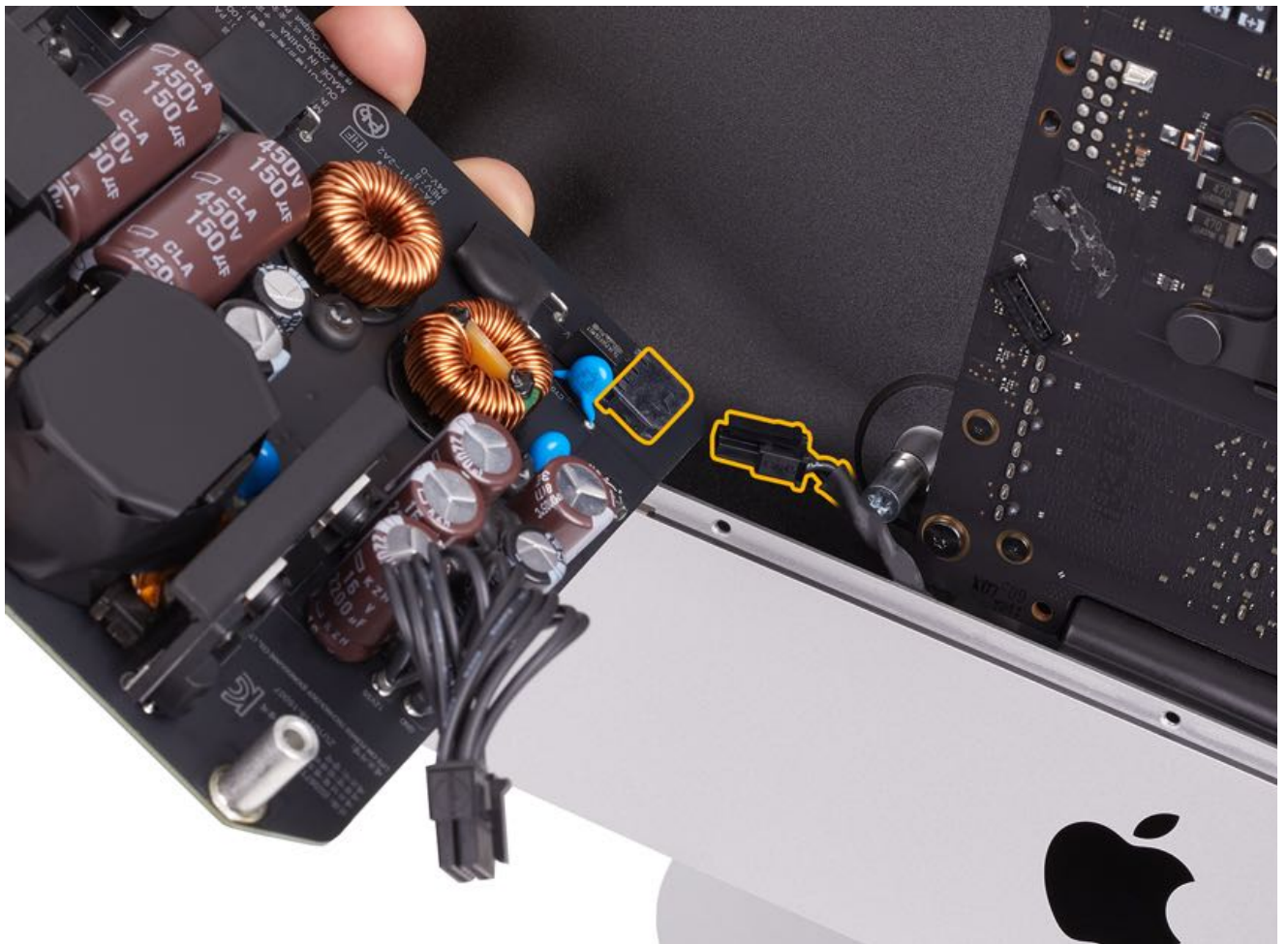
5. Tilt the power supply forward to disconnect the AC cable. Pinch the clip on the AC cable and pull to disconnect. Lift the power supply out of the rear housing.



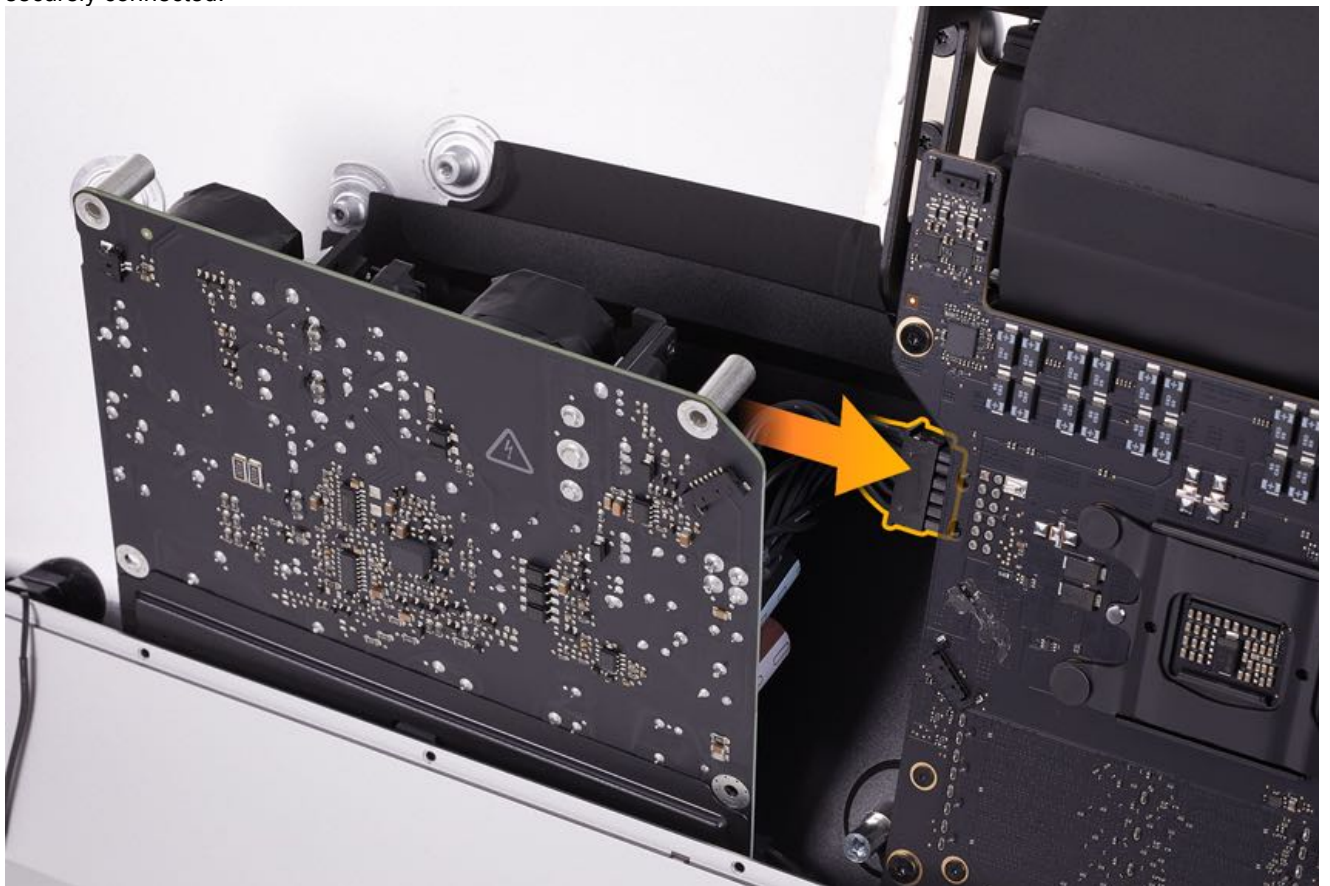
### Steps For Reassembly

1. Connect the AC cable to the power supply. Check that the cable is securely connected.

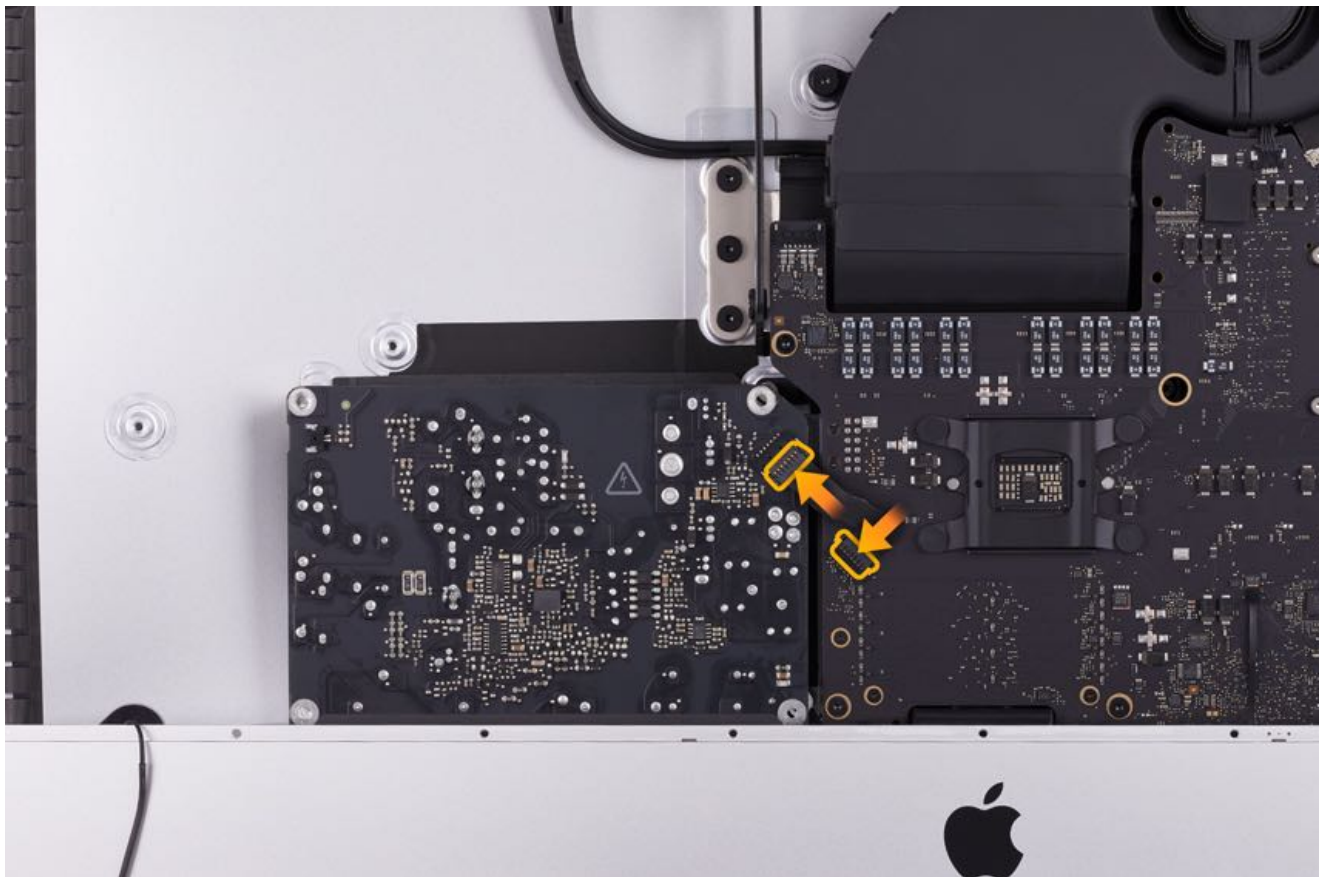




2. Lower the power supply into the rear housing and connect the DC cable to the logic board. Check that the cable is securely connected.



3. Connect the power signal cable to the power supply and logic board.



4. Reinstall the four T8 power supply screws.

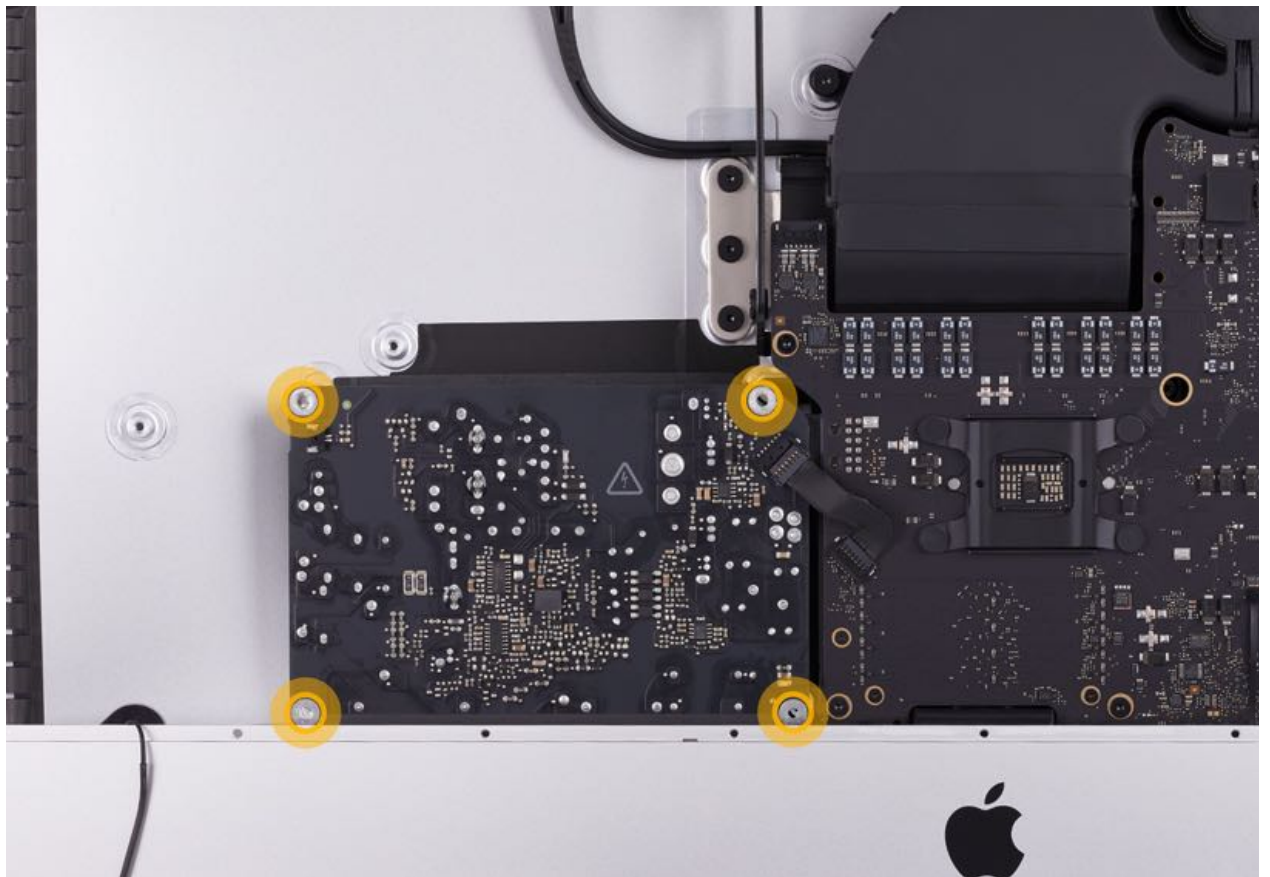
**Note:** Reinstall the two long screws (1) at the top first, then the two shorter screws (2) at the bottom.

1. 923-0396: two long screws on the top.



2. 923-0331: two short screws on the bottom.





5. Reinstall the [hard drive](#) (2019 only).
6. Reinstall the [left speaker](#).
7. Reinstall the display for the model you are repairing to complete reassembly:
  - [display reassembly](#) (2019)
  - [display reassembly](#) (2020)

# iMac (Retina 5K, 27-inch, 2020) Logic Board

## First Steps



### Warning! Electrical Shock Hazard:

- Never plug the computer in to an electrical outlet during a repair procedure.
  - The power supply and logic board remain powered when the computer is plugged in whether or not the computer has been turned on.
  - After unplugging the computer from the electrical outlet, wait two minutes for the power supply and logic board to discharge before removing the display, disconnecting modules, or substituting cables and components.
  - Do not perform any troubleshooting until [protective covers](#) (TP833) have been installed over the power supply and logic board.
  - You must follow additional [safety precautions](#) (TP820) when performing troubleshooting that requires you to operate the computer when it is plugged into an electrical outlet and the display is removed.
- 

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- You must perform [System Configuration](#) (TP1657) after a logic board or display repair.
- Some of the images in this procedure may be of a previous model, however the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- [Display](#)
- [Fan](#)
- [Left speaker](#)
- [Right speaker](#)
- [Power supply](#)





## Tools

1. Black stick
2. Antenna tool (923-01322)
3. Torx T5 screwdriver
4. Torx T8 screwdriver
5. Torx T10 screwdriver
6. Torx T25 screwdriver
7. Wireless support tool (923-03085)
8. USB-C cable, or SD Card (not shown)
9. iMac service wedge
10. Painters tape (1 to 2 inches or 2.5 to 5 cm wide)



## Steps For Removal



**Warning! Electrical Shock Hazard:** Verify the computer is unplugged from the electrical outlet. If the computer is plugged in to an electrical outlet, unplug it, then wait two minutes for the power supply and logic board to discharge before continuing.



**Caution:** Handling the logic board incorrectly can damage chips and circuits. Be extremely careful when removing and reinstalling the logic board. Components that contact the rear housing, standoffs, or other modules may cause damage and prevent the iMac from operating correctly. It is recommended you first read all the repair steps, then proceed with the repair.

1. Disconnect the following cables from the logic board:

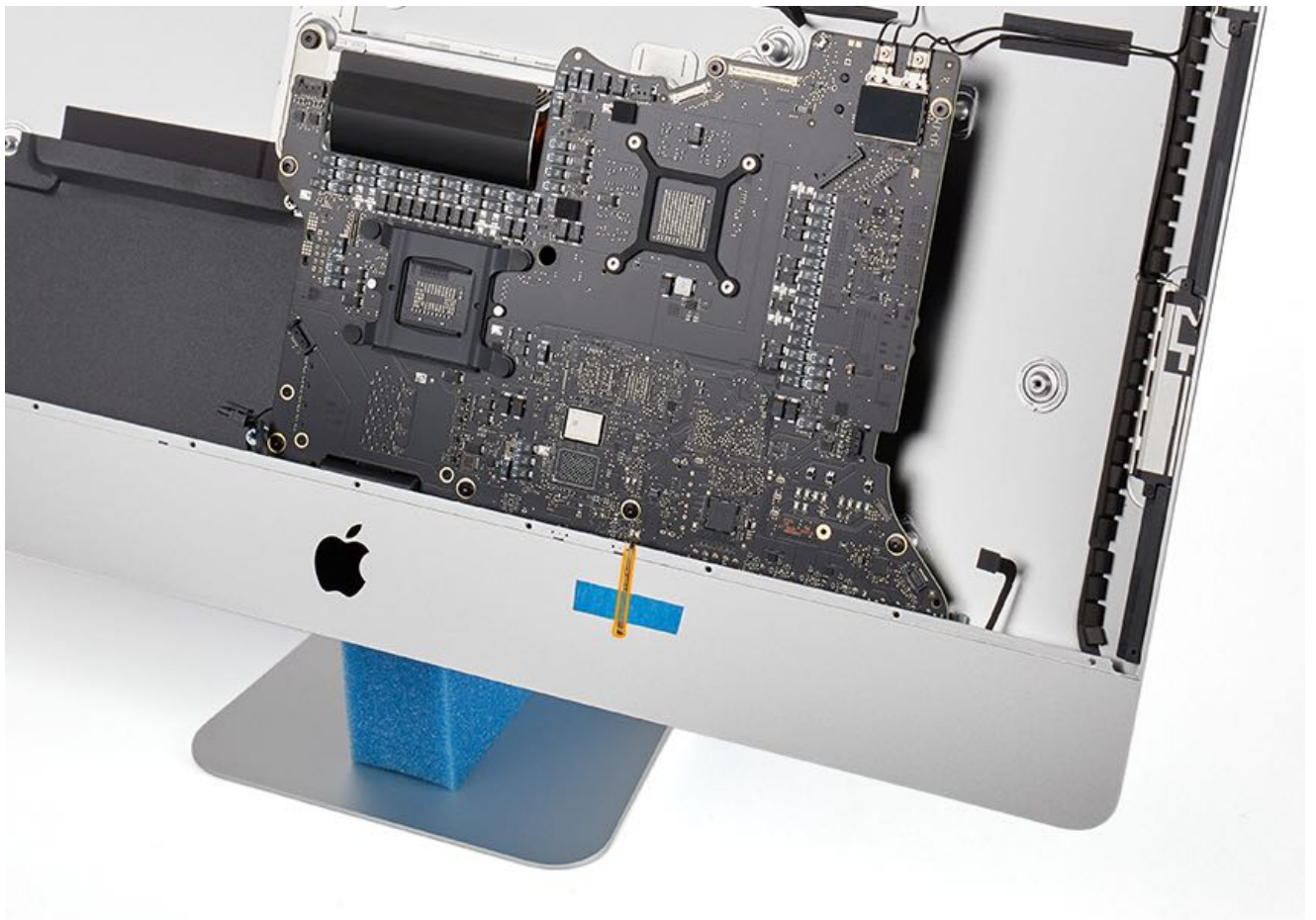
- (1) Rear microphone cable
- (2) Audio cable
- (3) Dual chin microphone cable

**Caution:** This is a locking lever cable. Ensure you have lifted the locking lever before you disconnect the cable.

2. Tape the dual chin microphones cable to the front of the chin.

**Caution:** Be careful not to crimp the cable. A damaged dual chin microphones cable requires a rear housing replacement.





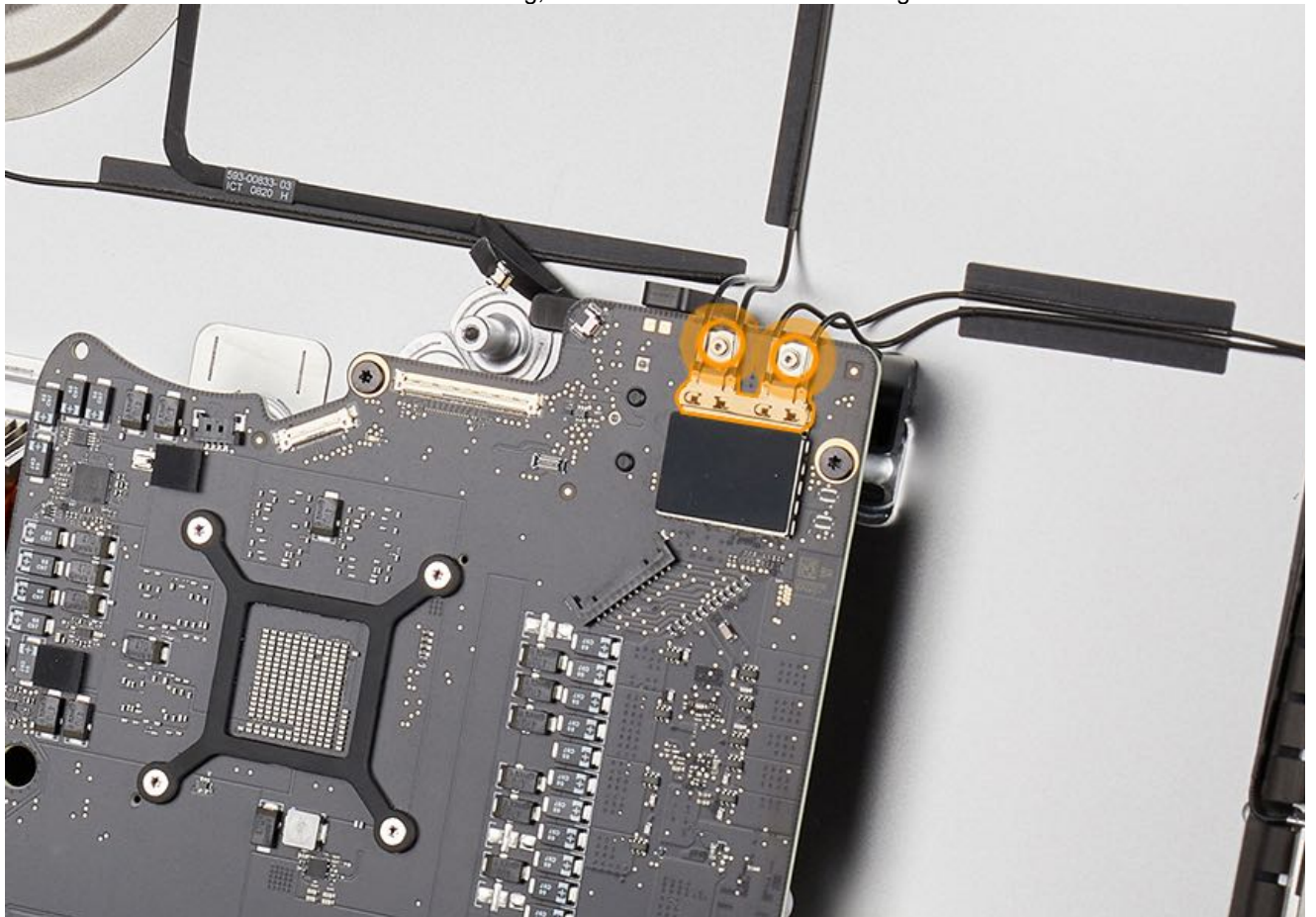
**Caution:** Avoid the coin cell battery when inserting the wireless support tool in step #3.



3. Position the wireless support tool between the logic board and rear housing, then slide it behind the antenna connectors.

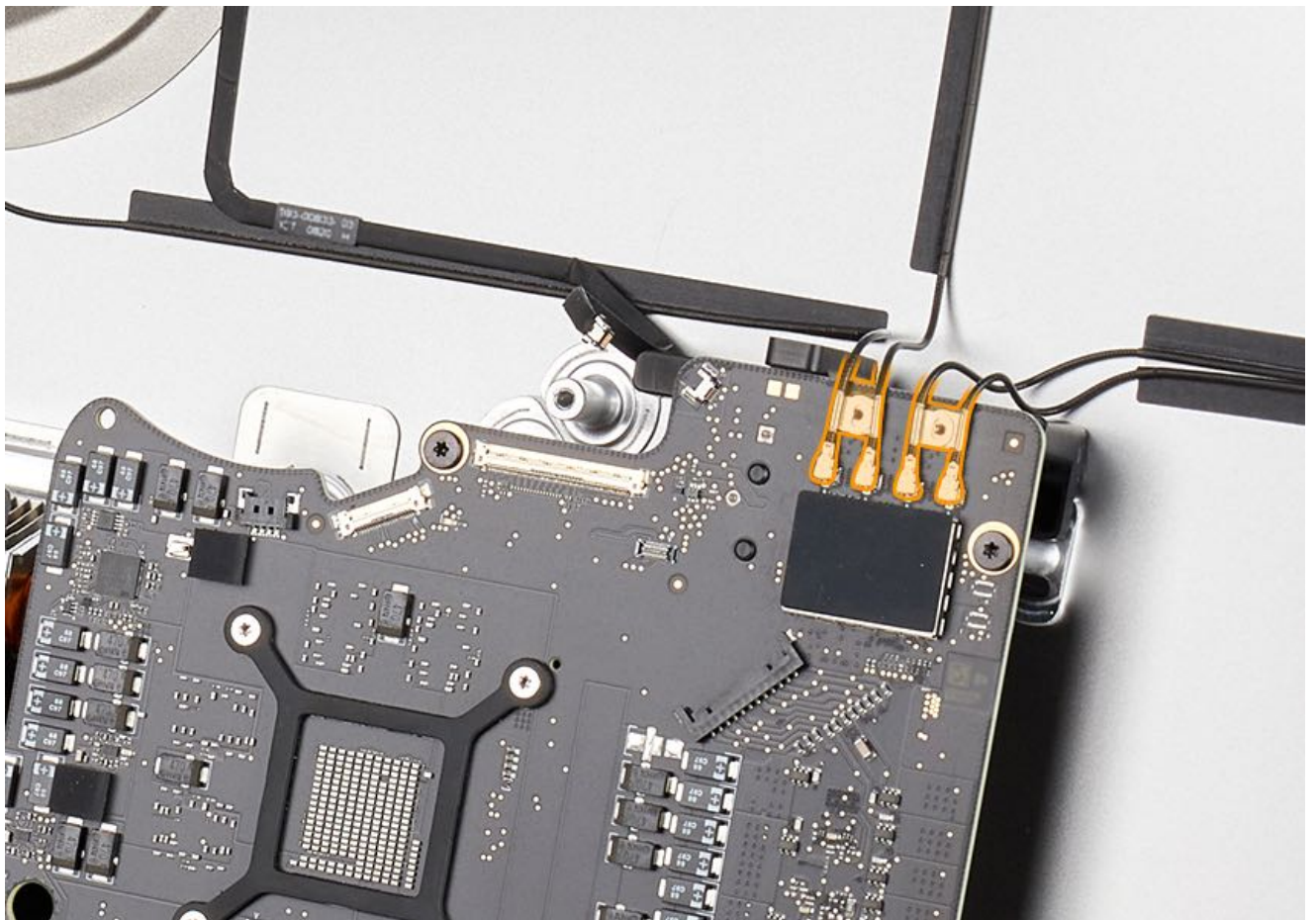


4. Remove two T5 screws from the antenna cowling, then remove the antenna cowling.



5. Use the antenna tool to disconnect the four antenna cables from the logic board.  
**Note:** Refer to the [wireless antenna connectors video](#) (SV91) for additional guidance on disconnecting the antenna cables.





6. Remove the wireless support tool.

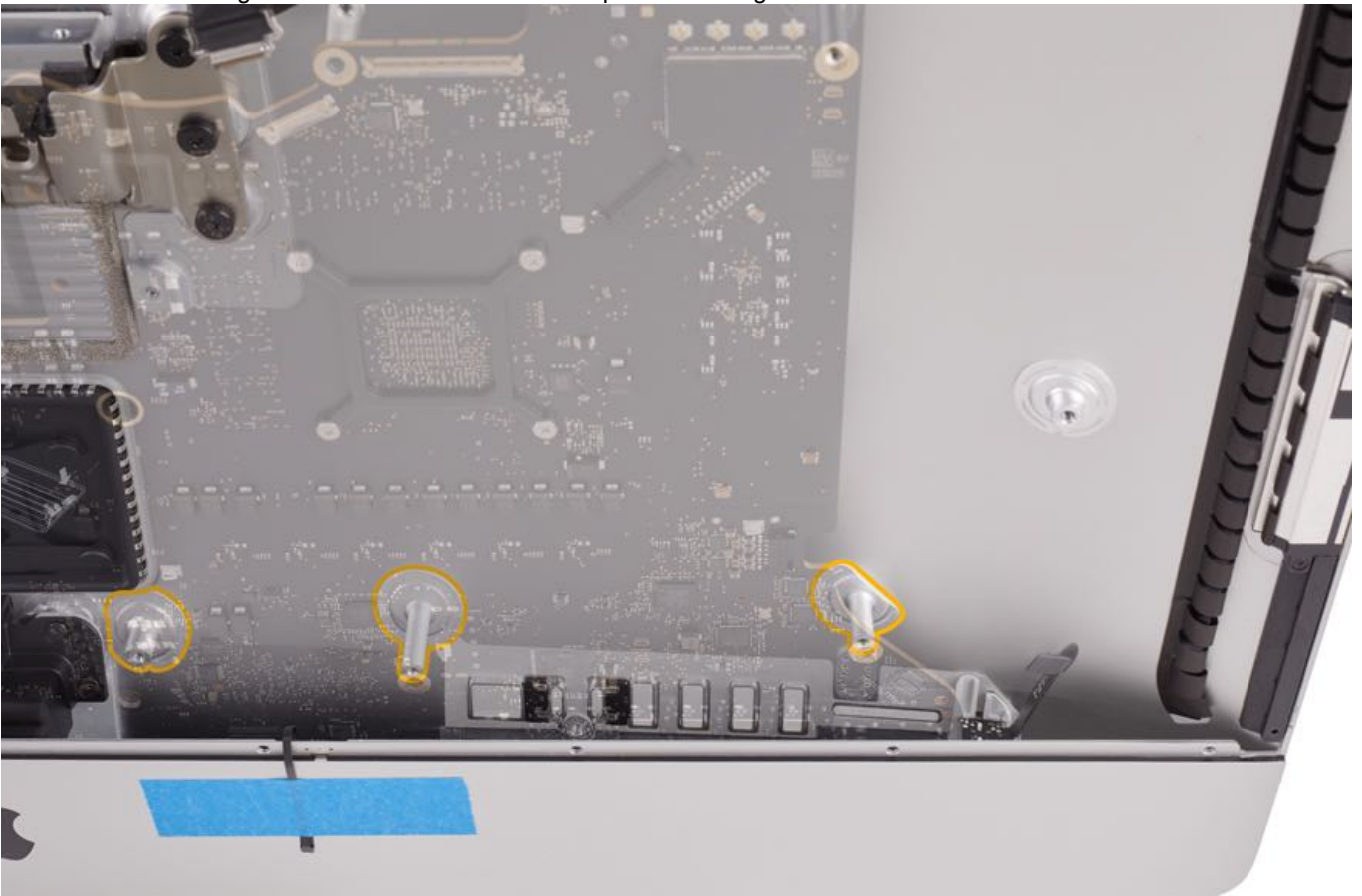


7. Remove the screws identified in the image below. Completely unscrew, but don't remove, one captive T8 screw (4) from the center of the logic board.

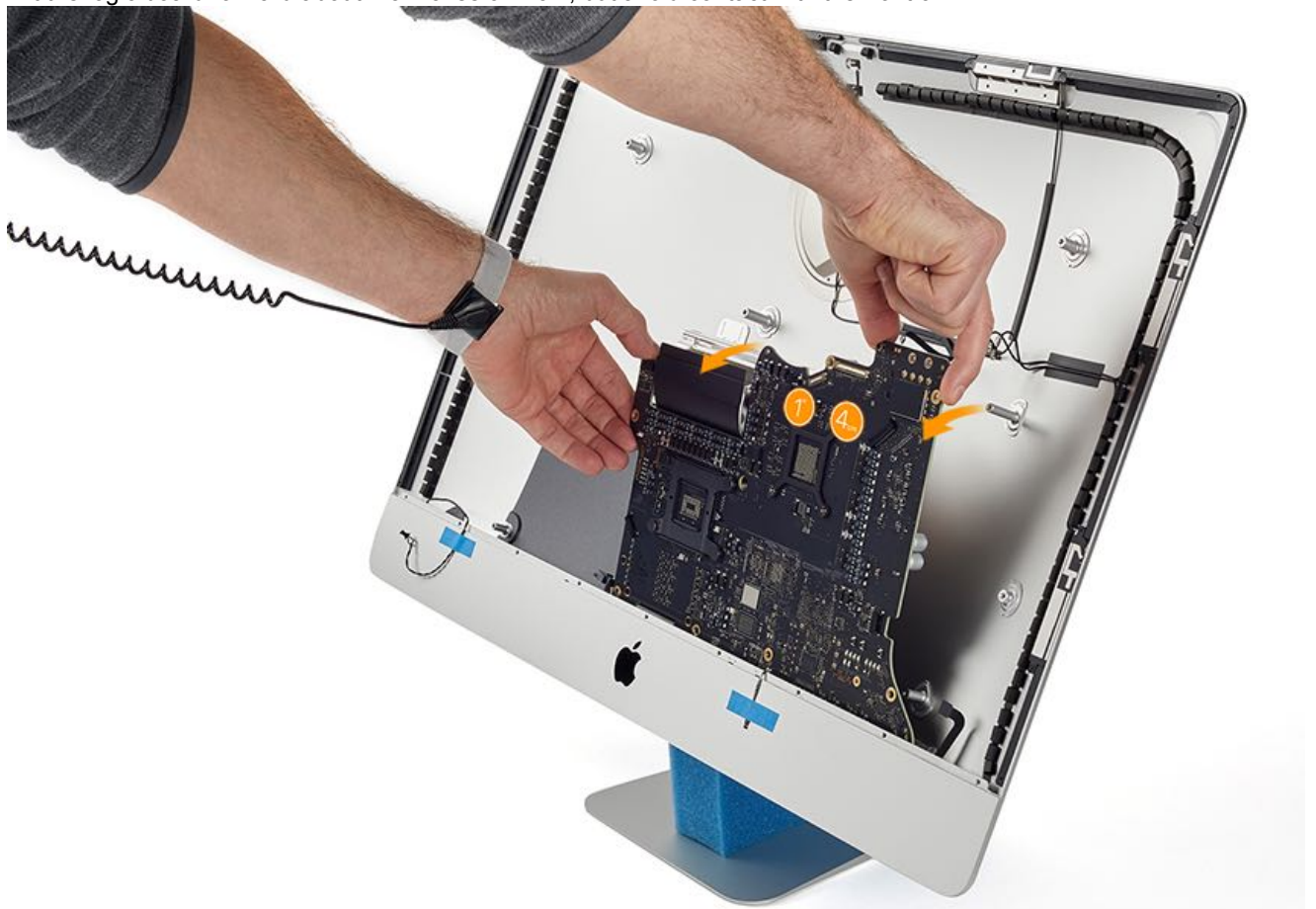
- (1) Four T8 screws (short)
- (2) One T8 screw (medium)
- (3) Two T8 screws (long)
- (4) One T8 screw (captive, can't be removed or replaced)
- (5) Two T10 shoulder screws
- (6) One T25 standoff screw



**Caution:** Review steps 8-11 before proceeding. Be extremely careful when removing and reinstalling the logic board. You must maneuver the logic board around the standoffs to prevent damage.

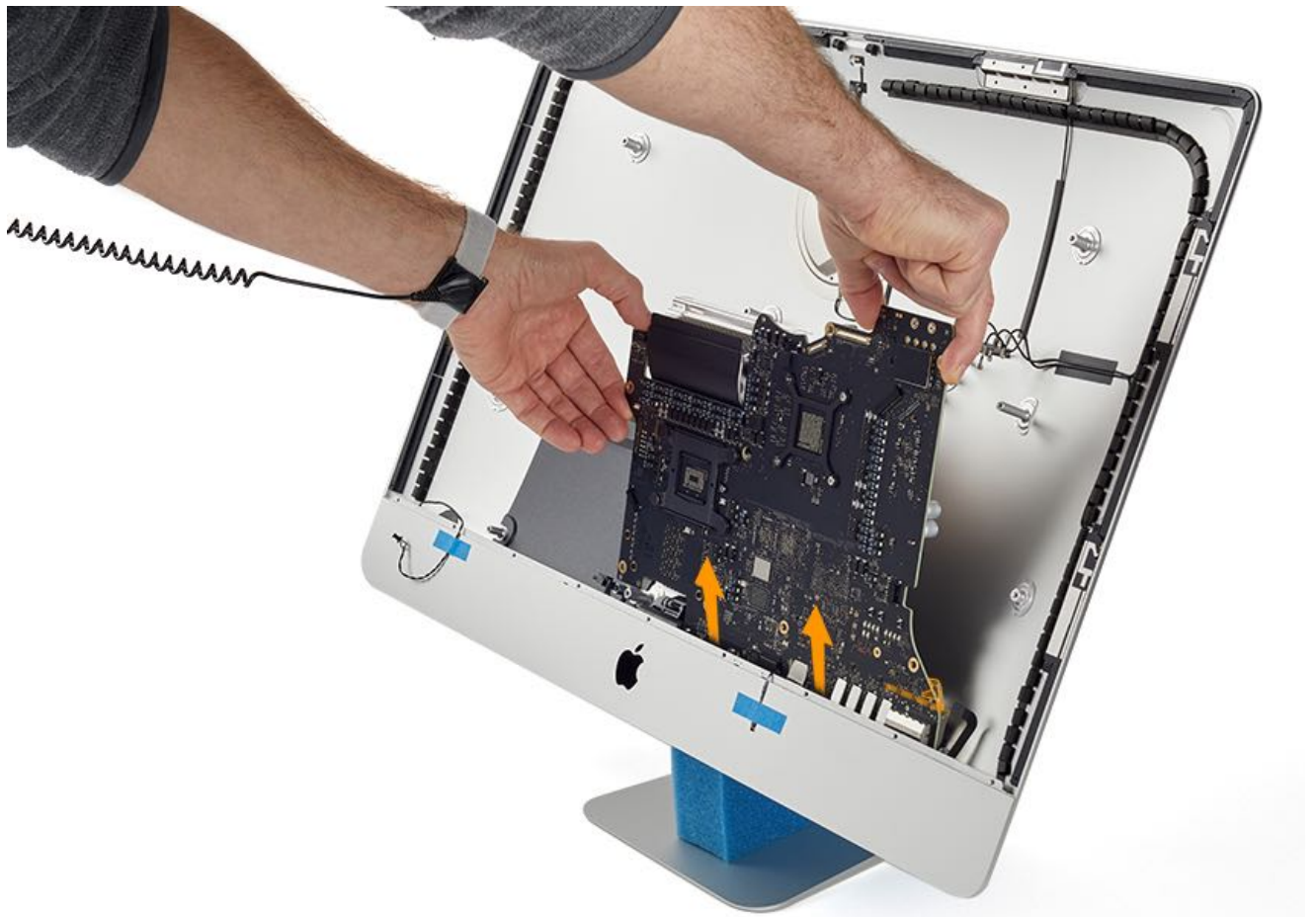


8. Tilt the logic board forward about 1.5-inches or 4 cm, but avoid contact with the front chin.

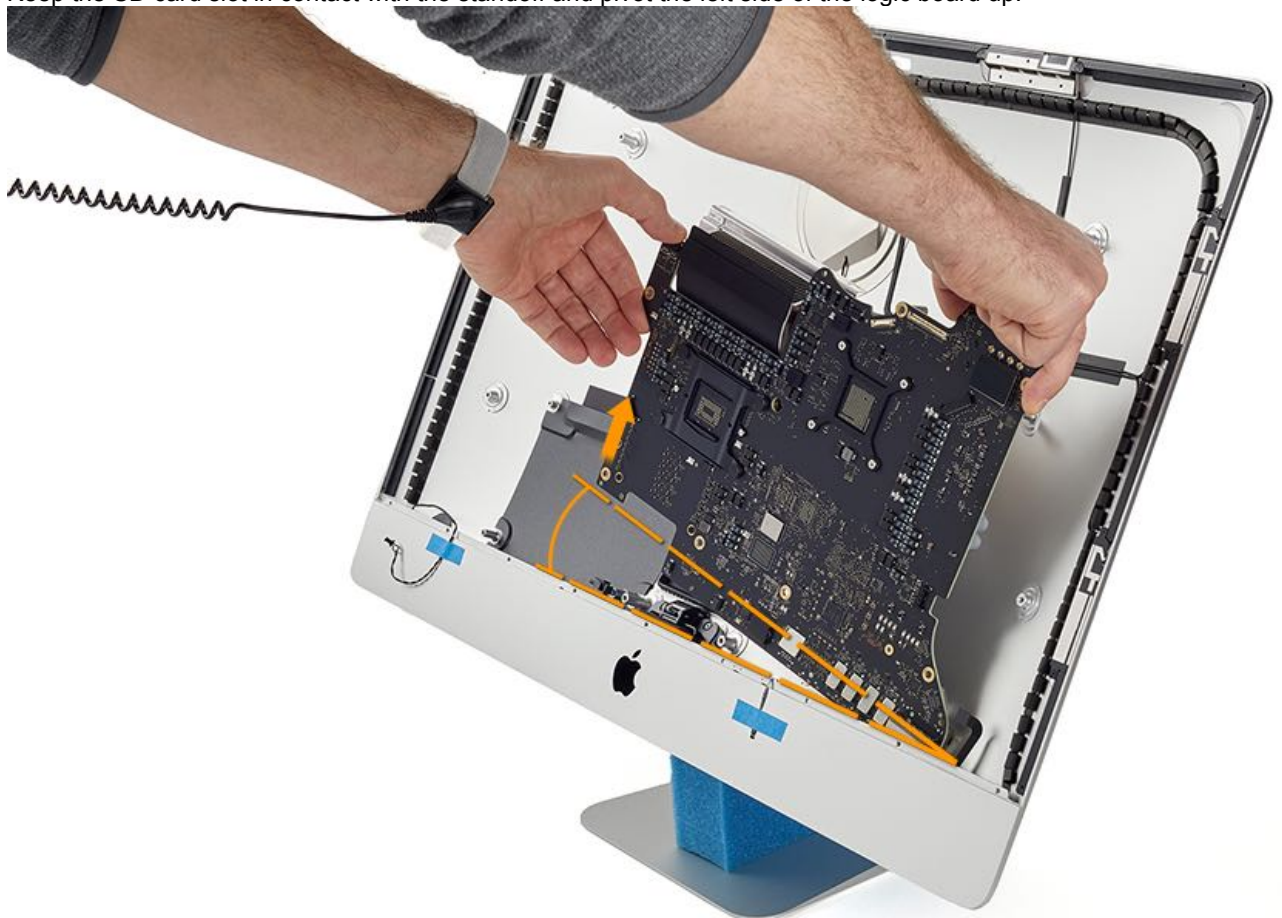


9. Lift the logic board straight up until the SD card slot touches the standoff on the rear housing.

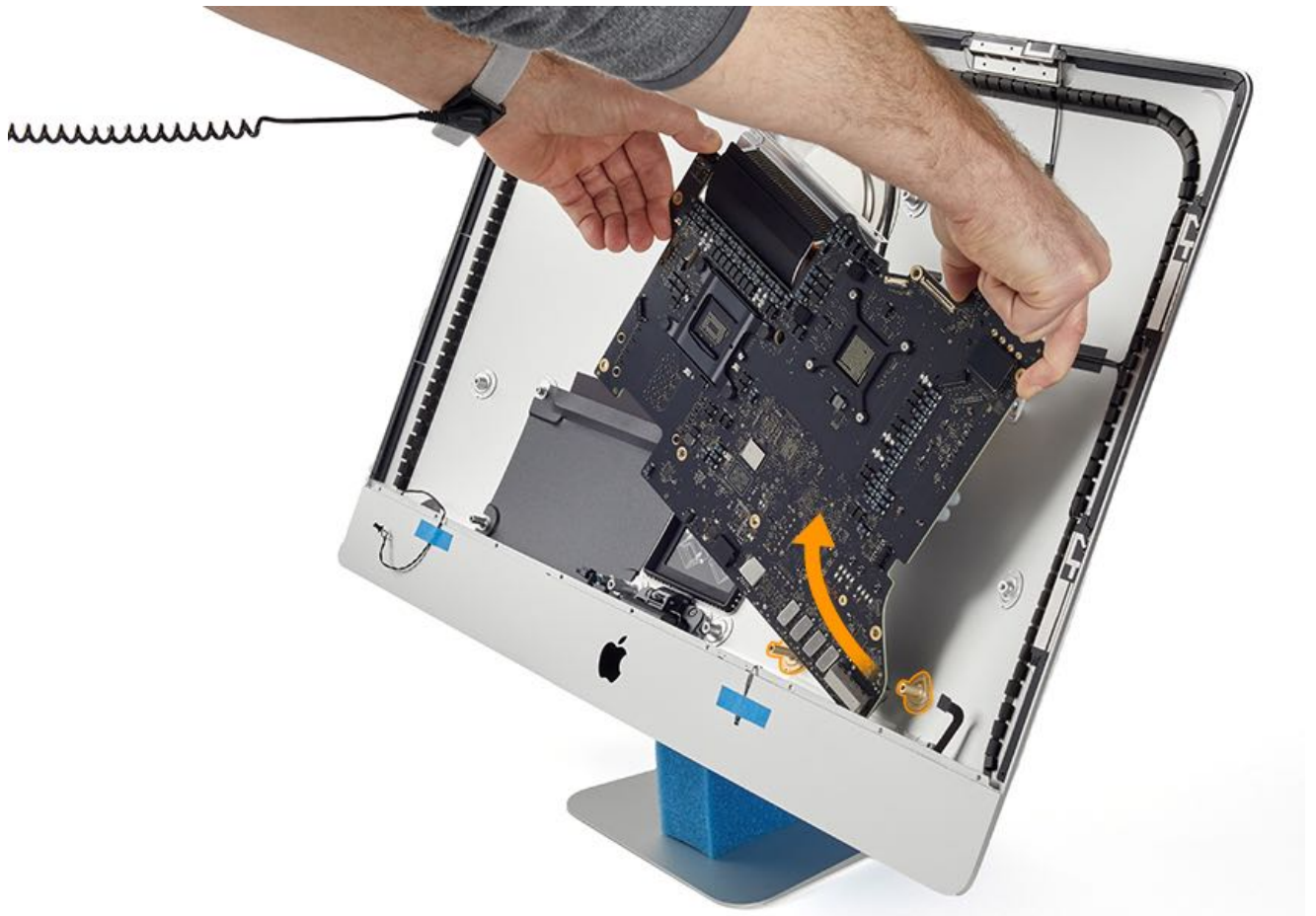




10. Keep the SD card slot in contact with the standoff and pivot the left side of the logic board up.

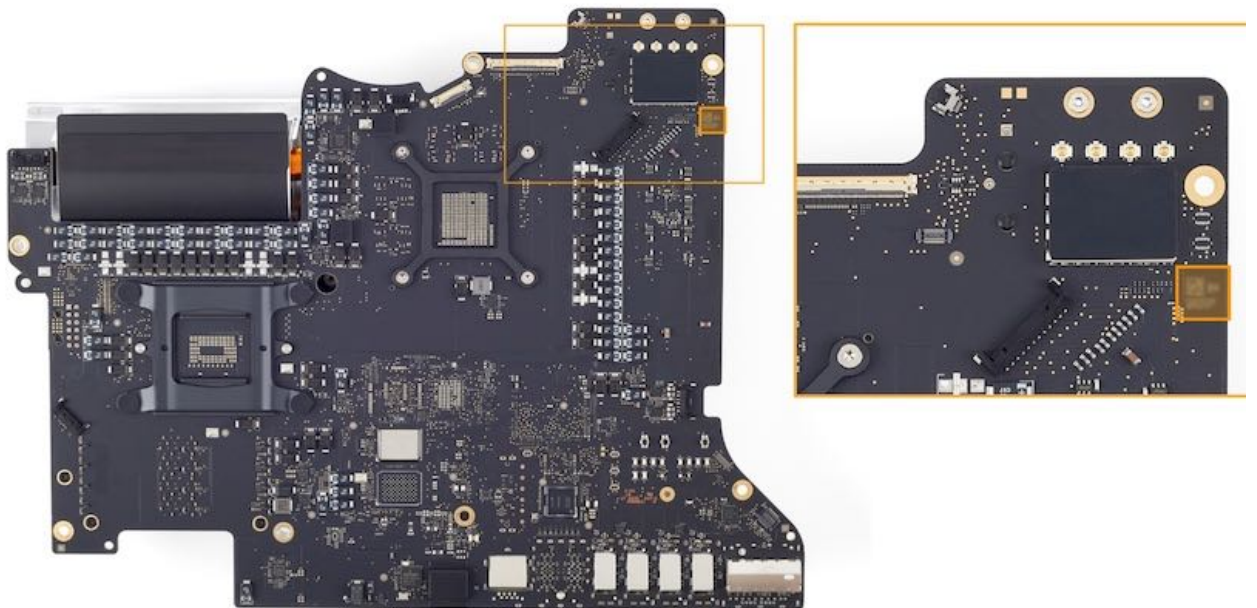


11. When you can see the standoff near the dual microphone cable, slide the logic board up and out to the left.



## Steps For Reassembly

1. If you are installing a replacement logic board:
  - Transfer the [memory](#) from the original logic board to the replacement logic board.
  - Apply a new Ethernet ID label (included in the box with the replacement logic board) to the bottom of the stand or underside of the VESA mount adapter.
  - Add the logic board part to the repair system, scan the 2D barcode on the original logic board and on the replacement logic board, then save the repair. This is required in order to run [System Configuration](#) after you have reassembled the computer.

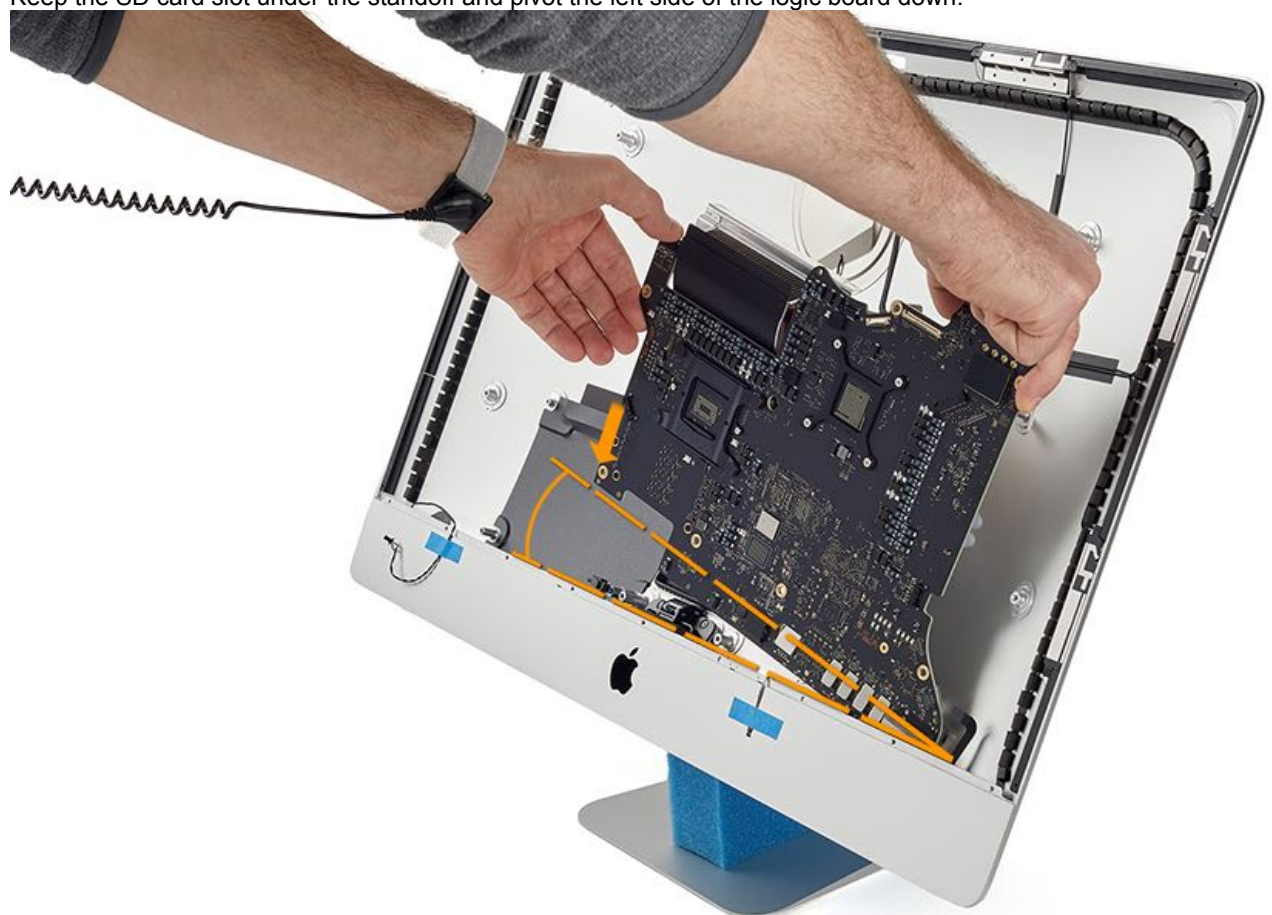


2. Lower the bottom right corner of the logic board into the rear housing. Position the SD card slot just under the lower right standoff in the rear housing. Avoid contact with the front chin.





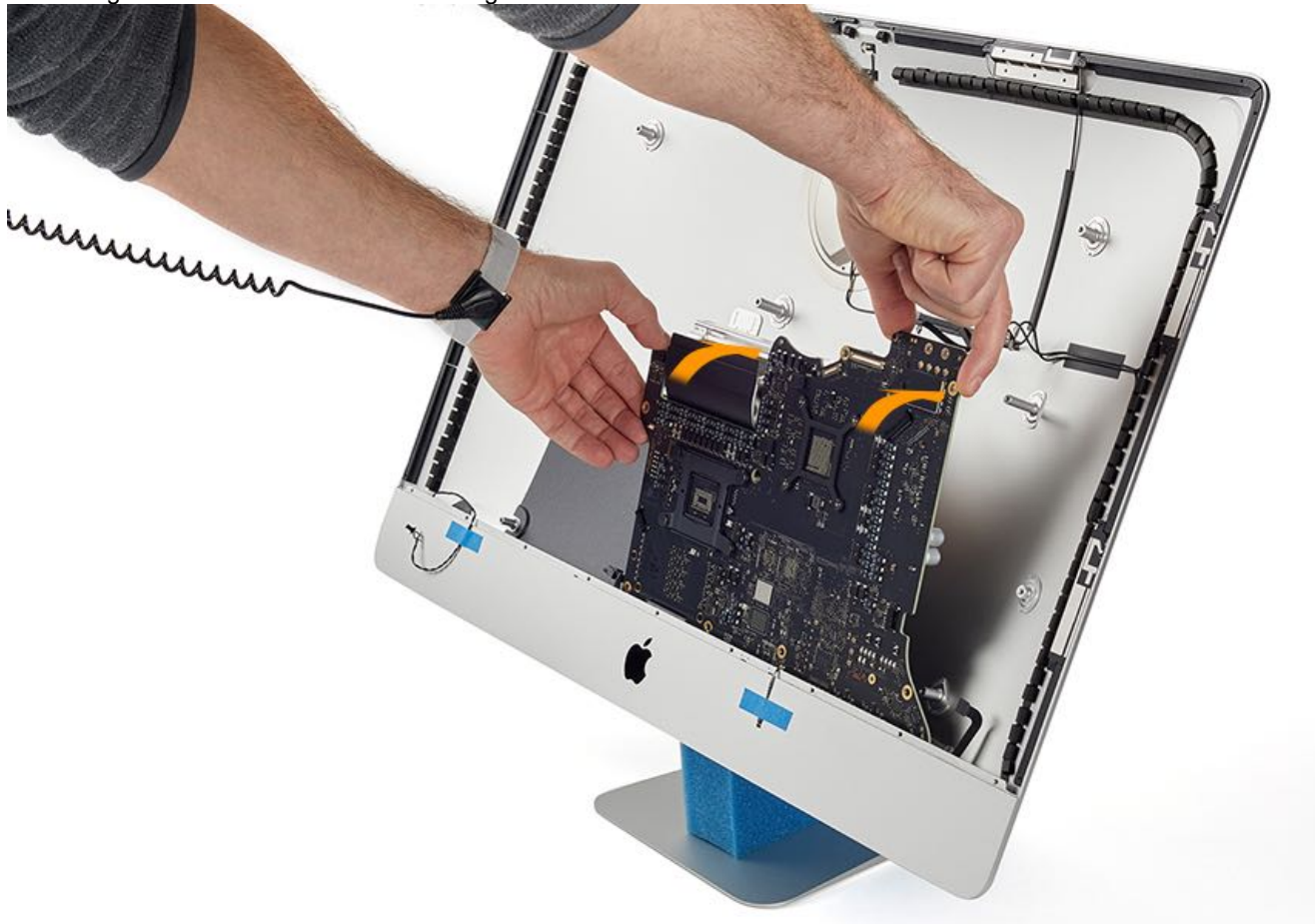
3. Keep the SD card slot under the standoff and pivot the left side of the logic board down.



4. When the bottom of the logic board is parallel to the chin, lower the logic board straight down.



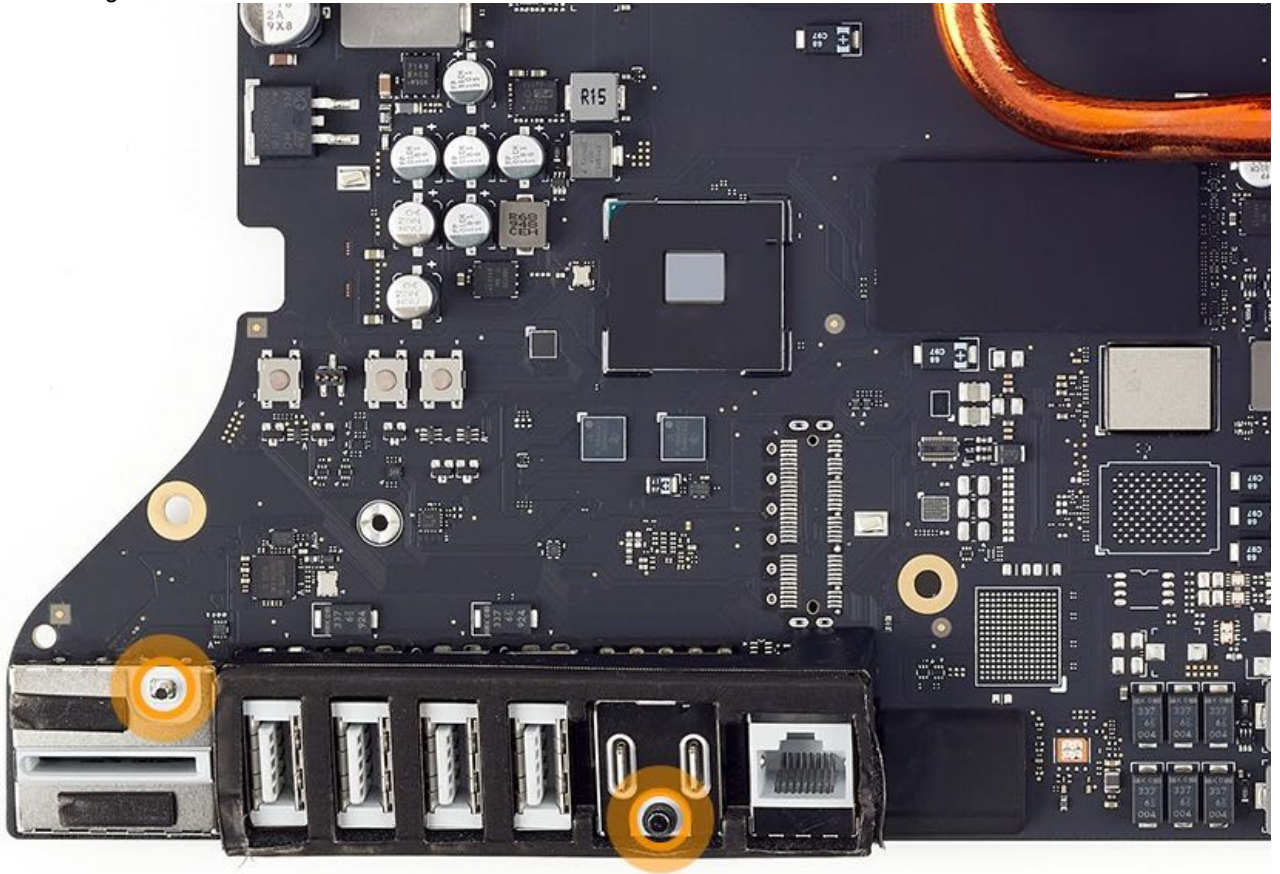
5. Tilt the logic board back into the rear housing.



**Important:** There are two alignment pins on the back of the logic board, one below the USB 3 ports and one above the SD card slot. There are two corresponding alignment holes in the rear housing. You can't see the alignment pins or the alignment holes when reinstalling the logic board, however you should feel the alignment pins insert into the alignment holes



in the rear housing.



6. Partially reinstall the 11 logic board screws.

**Note:** Do not fully tighten the screws until you have verified alignment in steps 7 and 8.

**1** = Four short T8 screws  
923-0331

**2** = One medium T8 screw  
923-00767

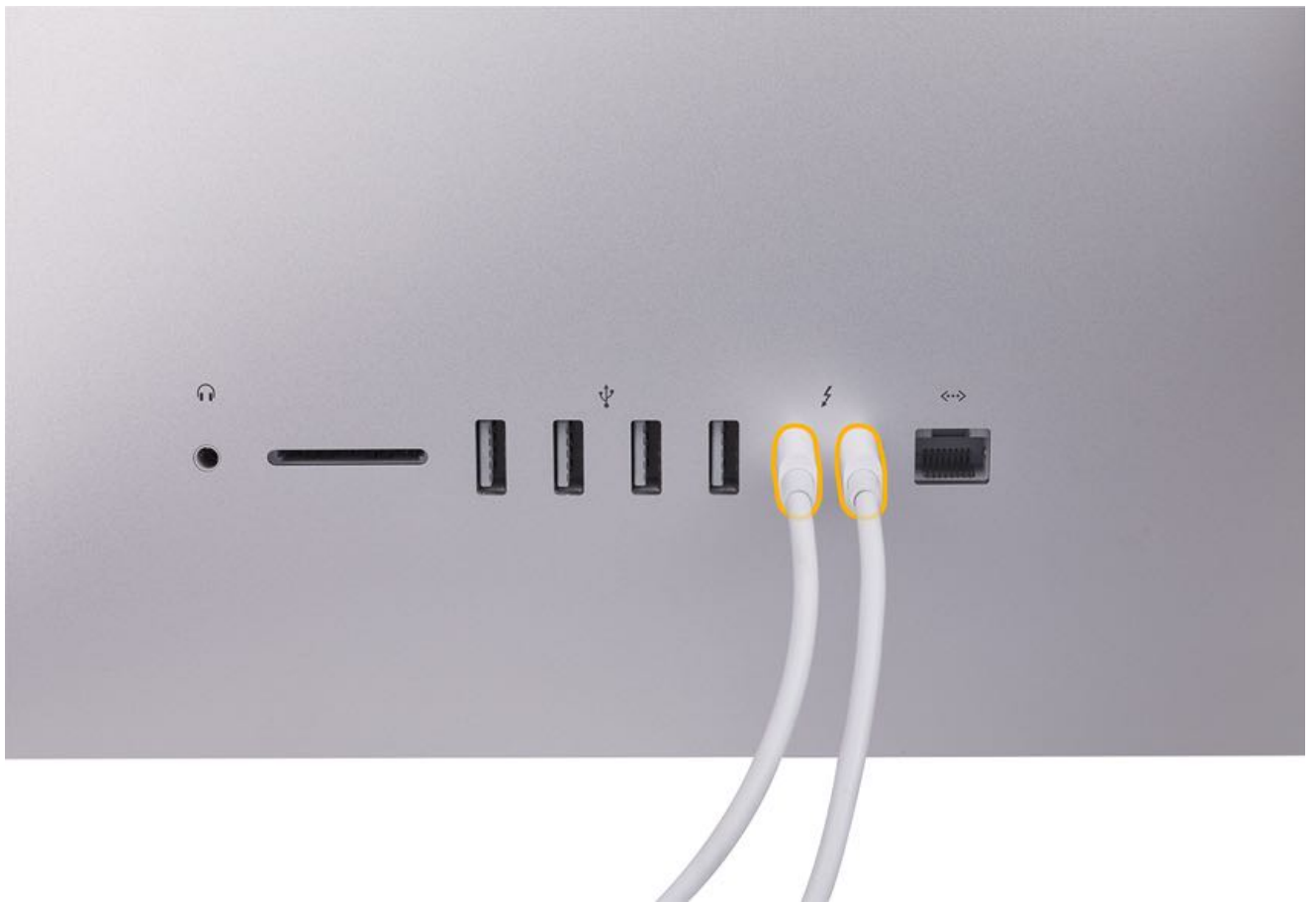
**3** = Two long T8 screw  
923-0396

**4** = One captive T8 screw  
(this screw cannot be removed or replaced)

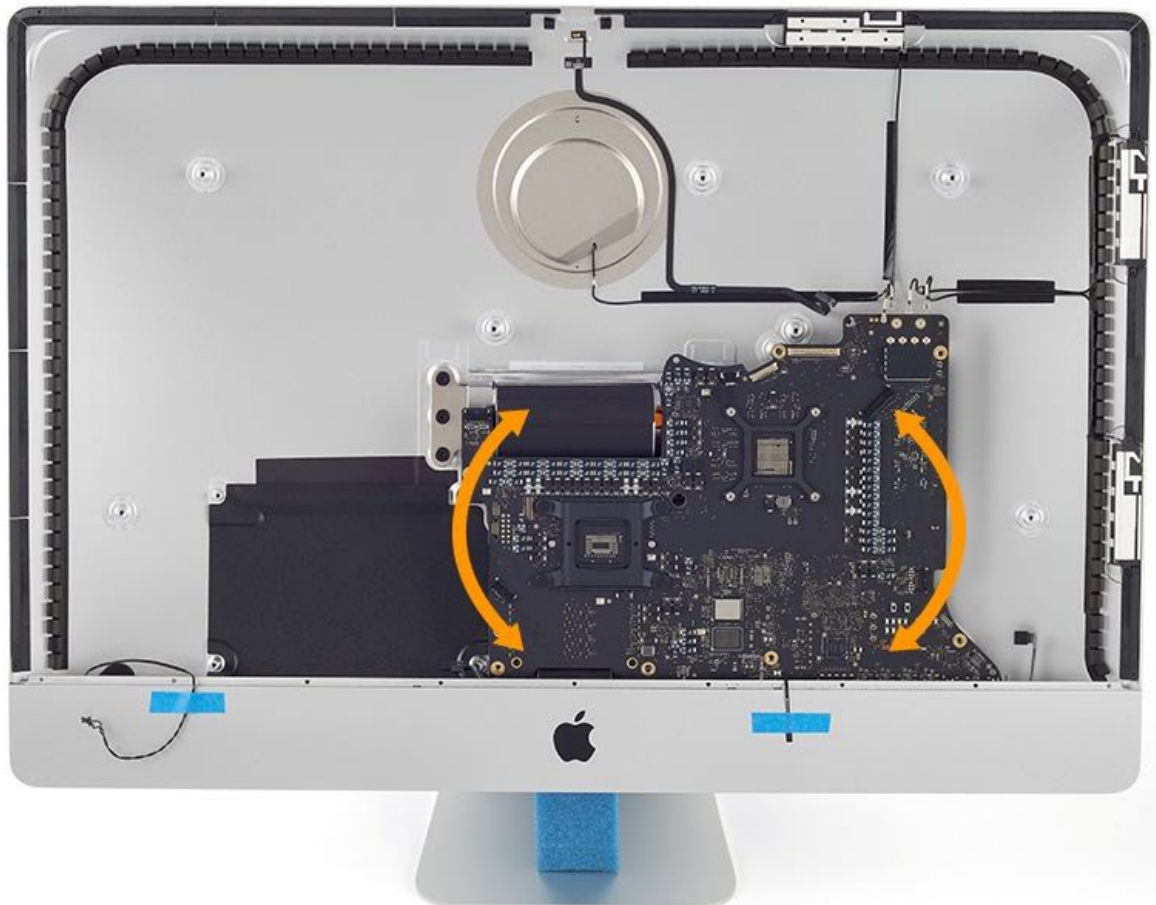
**5** = Two T10 shoulder screws  
923-0395

**6** = One T25 standoff screw  
923-0520

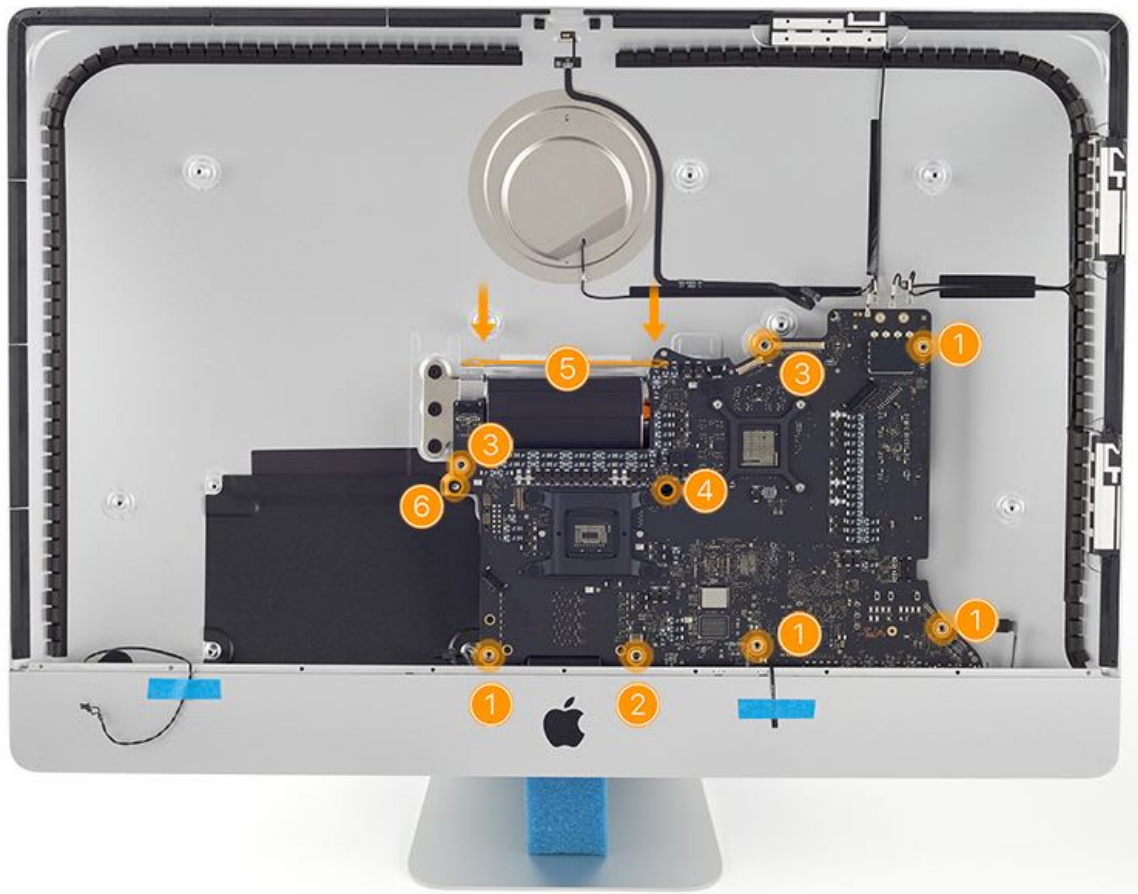
7. To verify the logic board is properly aligned in the rear housing, rotate the computer to access the IO ports. Plug both ends of a USB-C cable into the USB-C ports or insert an SD card into the SD card slot.



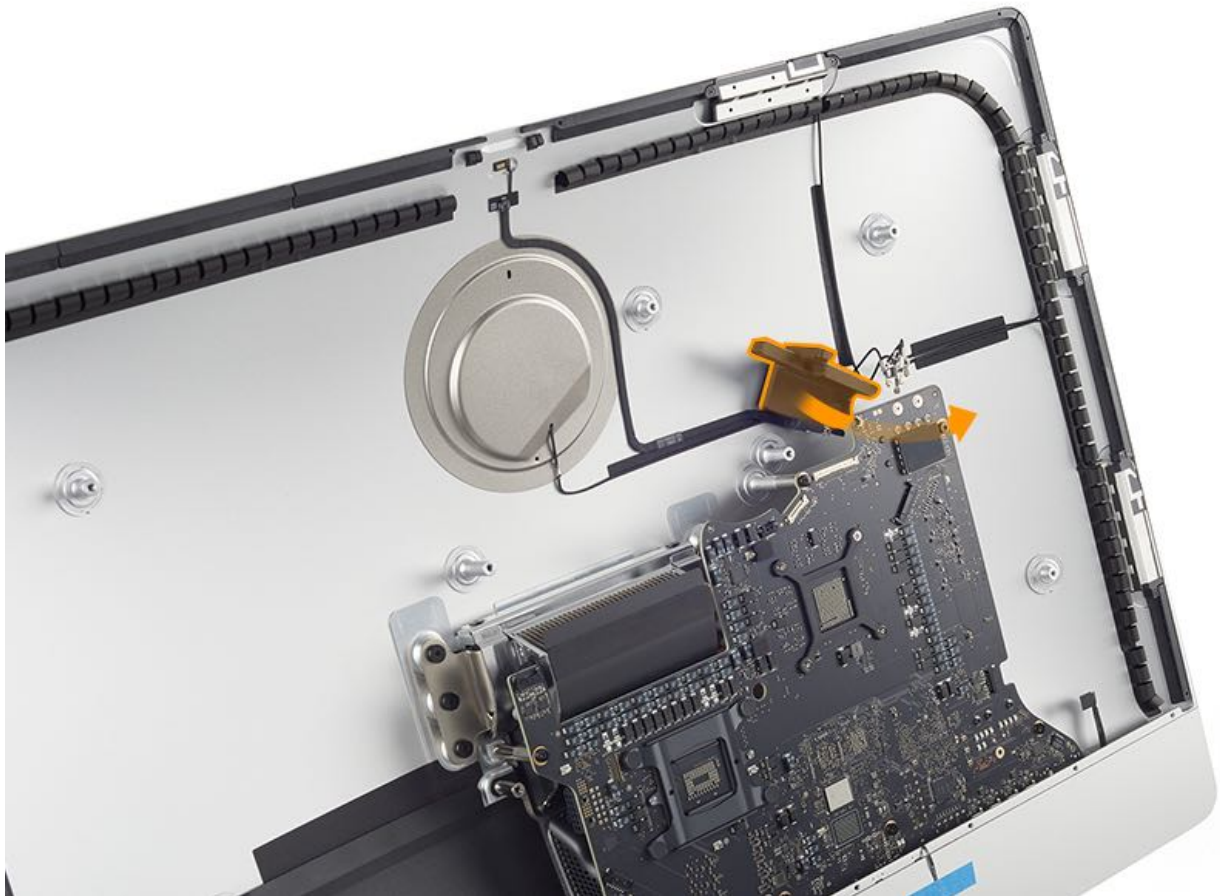
8. If you feel resistance when inserting the USB-C cable or SD card, turn the computer around and further loosen the logic board screws. Gently wiggle the edges of the logic board until you feel it settle into place.



9. Once the logic board is properly aligned, fully tighten the logic board screws.

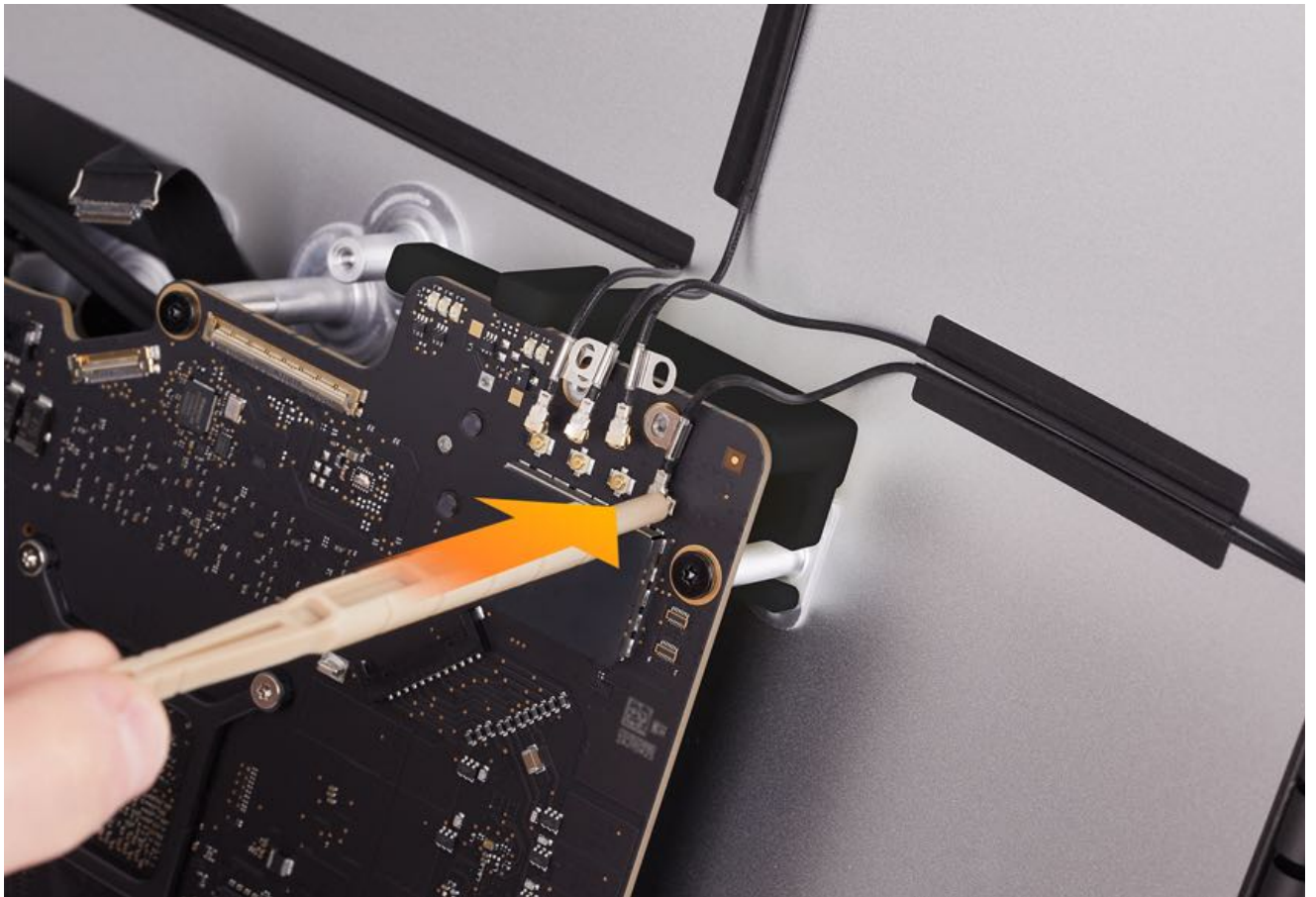


10. Position the wireless support tool between the logic board and rear housing, then slide it behind the antenna connectors.

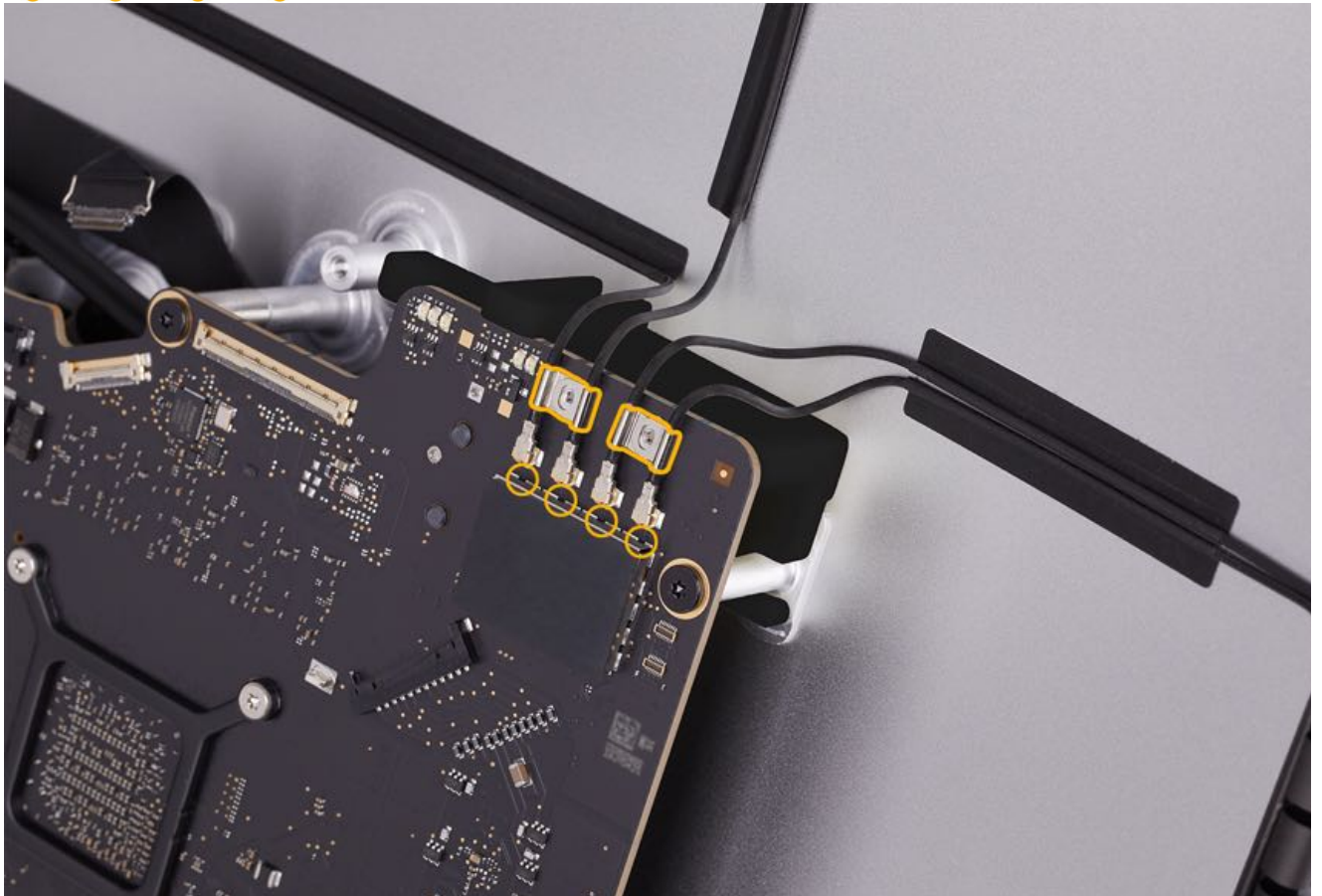
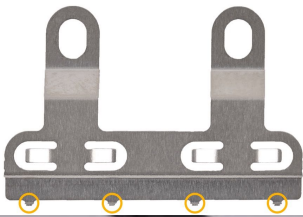


11. Reconnect the antennas to the logic board using the flat side of the antenna tool. If necessary, use ESD-safe tweezers to align the antennas over the connectors.



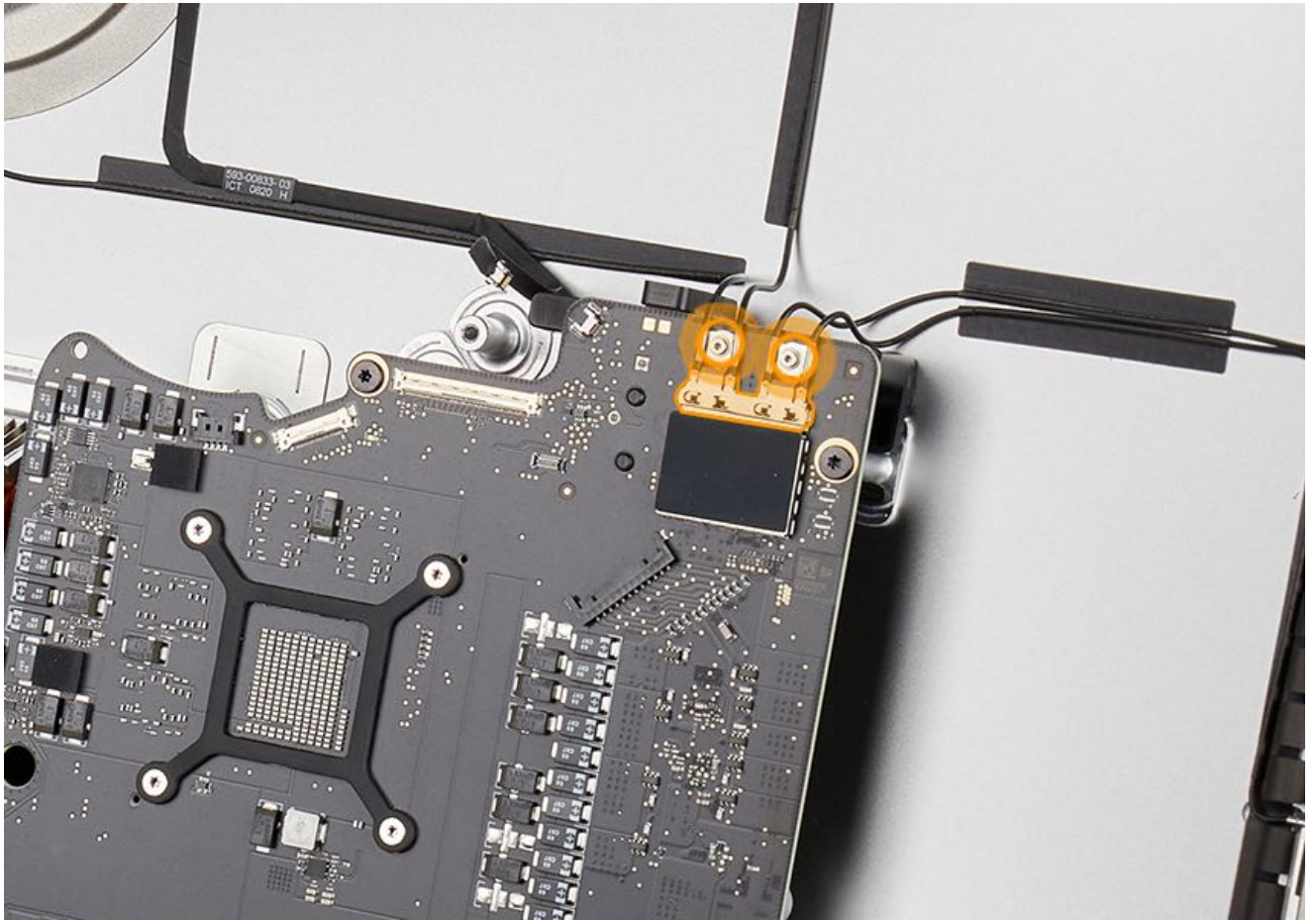


12. Insert the antenna cowling (923-04252) at an angle to engage the teeth in the slots, then lay it flat over the antenna connectors.



13. Reinstall the two T5 (923-02294) screws in the antenna cowling.



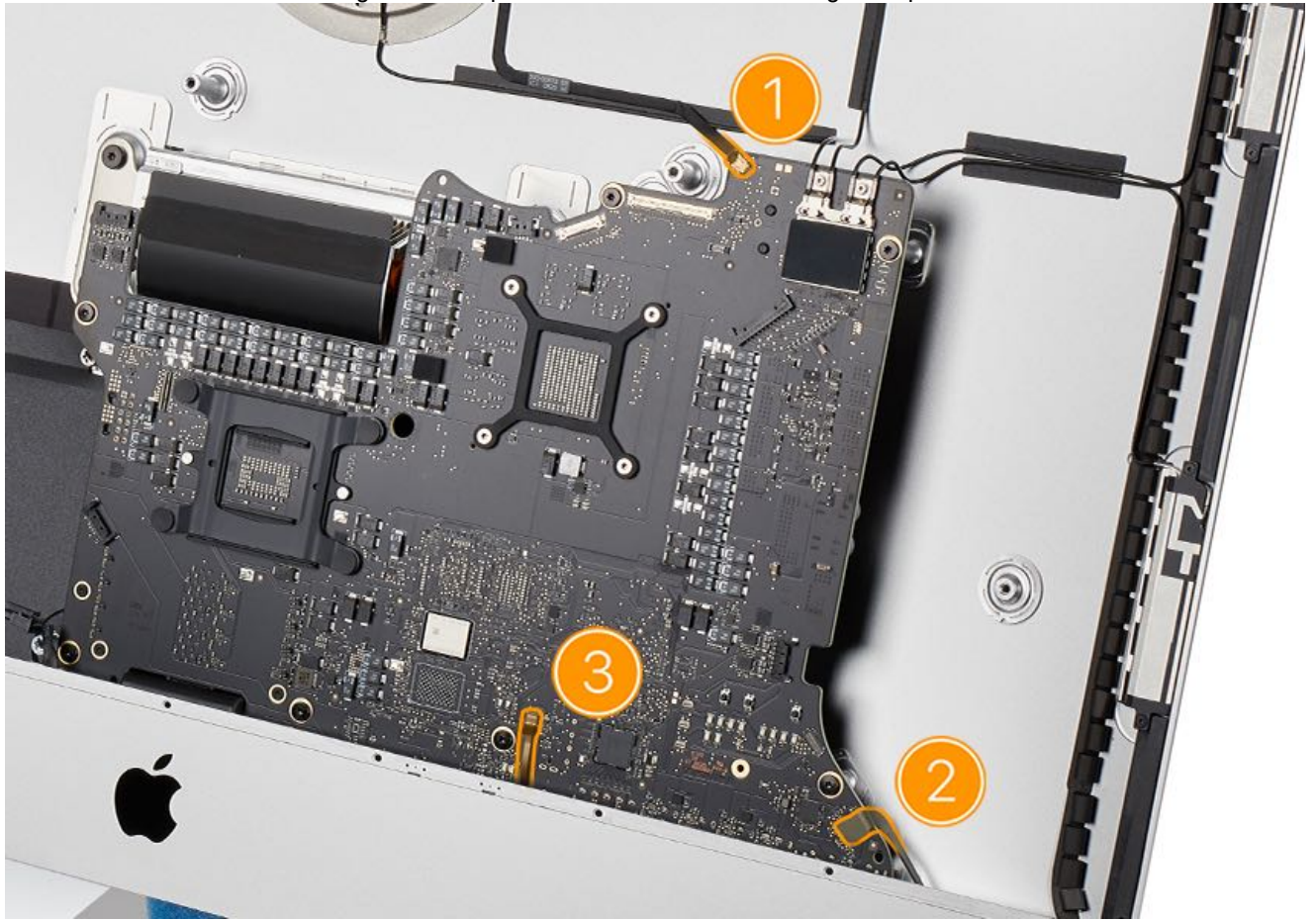


14. Remove the wireless support tool.



15. Reconnect the rear microphone cable (1), audio cable (2), and dual chin microphones cable (3) to the logic board:

**Caution:** Be careful not to damage the microphone flex cable when removing the tape.



16. Reinstall the [power supply](#).
17. Reinstall the [right speaker](#).
18. Reinstall the [left speaker](#).
19. Reinstall the [fan](#).
20. Reinstall the [display](#).
21. If you replaced the logic board, run [System Configuration](#) (TP1657).
22. Run the [required AST 2 diagnostics for the parts that you replaced](#) (TP1854).



# iMac (Retina 5K, 27-inch, 2019 and 2020) Battery

## First Steps

### Caution:

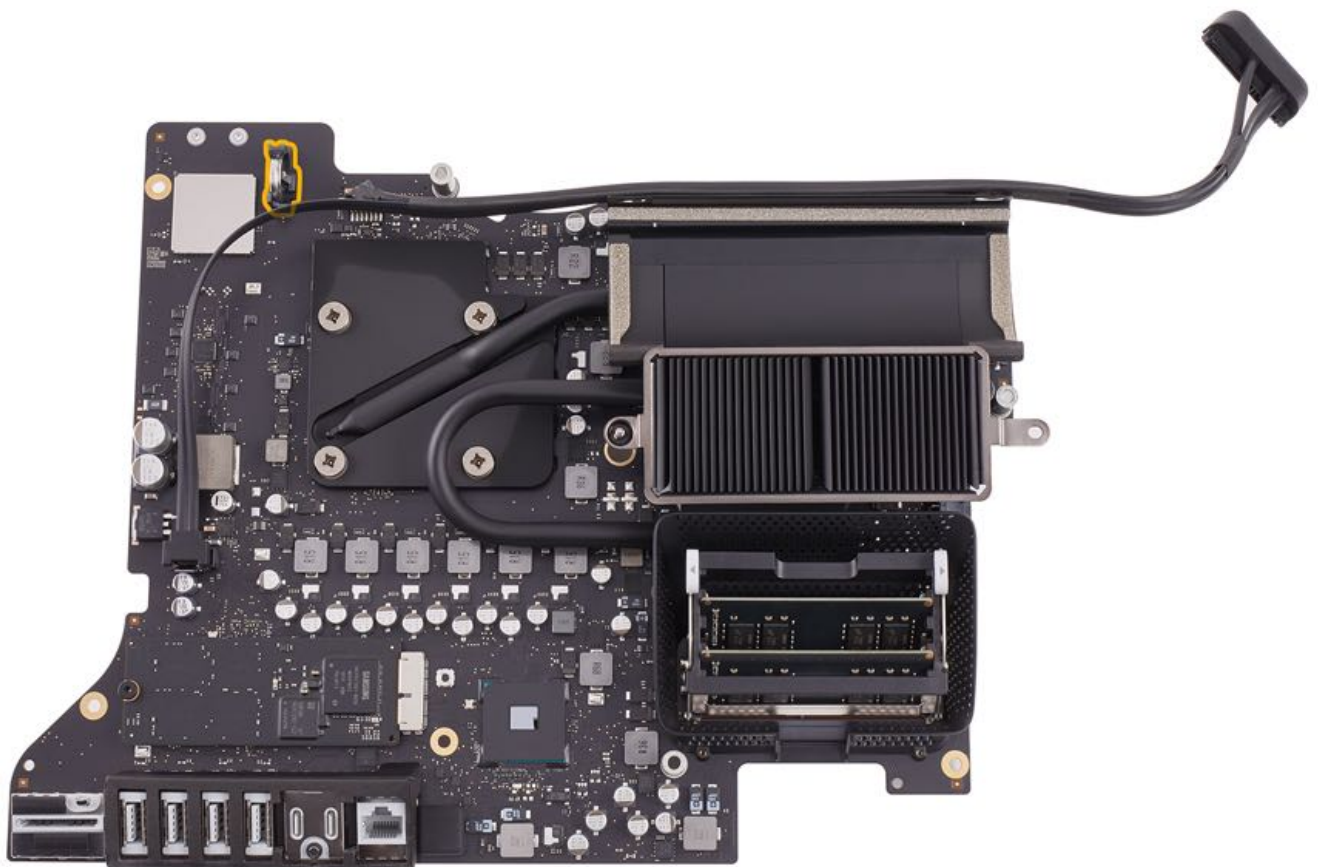
- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- Images in this procedure show the iMac (Retina 5K, 27-inch, 2019), but the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- Display
  - [Display removal](#) (2019)
  - [Display removal](#) (2020)
- Fan
  - [Fan](#) (2019)
  - [Fan](#) (2020)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#) (2019 only)
- [Power supply](#)
- Logic board
  - [Logic board](#) (2019)
  - [Logic board](#) (2020)



## Tools

No tools are required for this procedure.

## Steps For Removal

1. Grasp the battery with two fingers and pull it up from the socket to remove it.

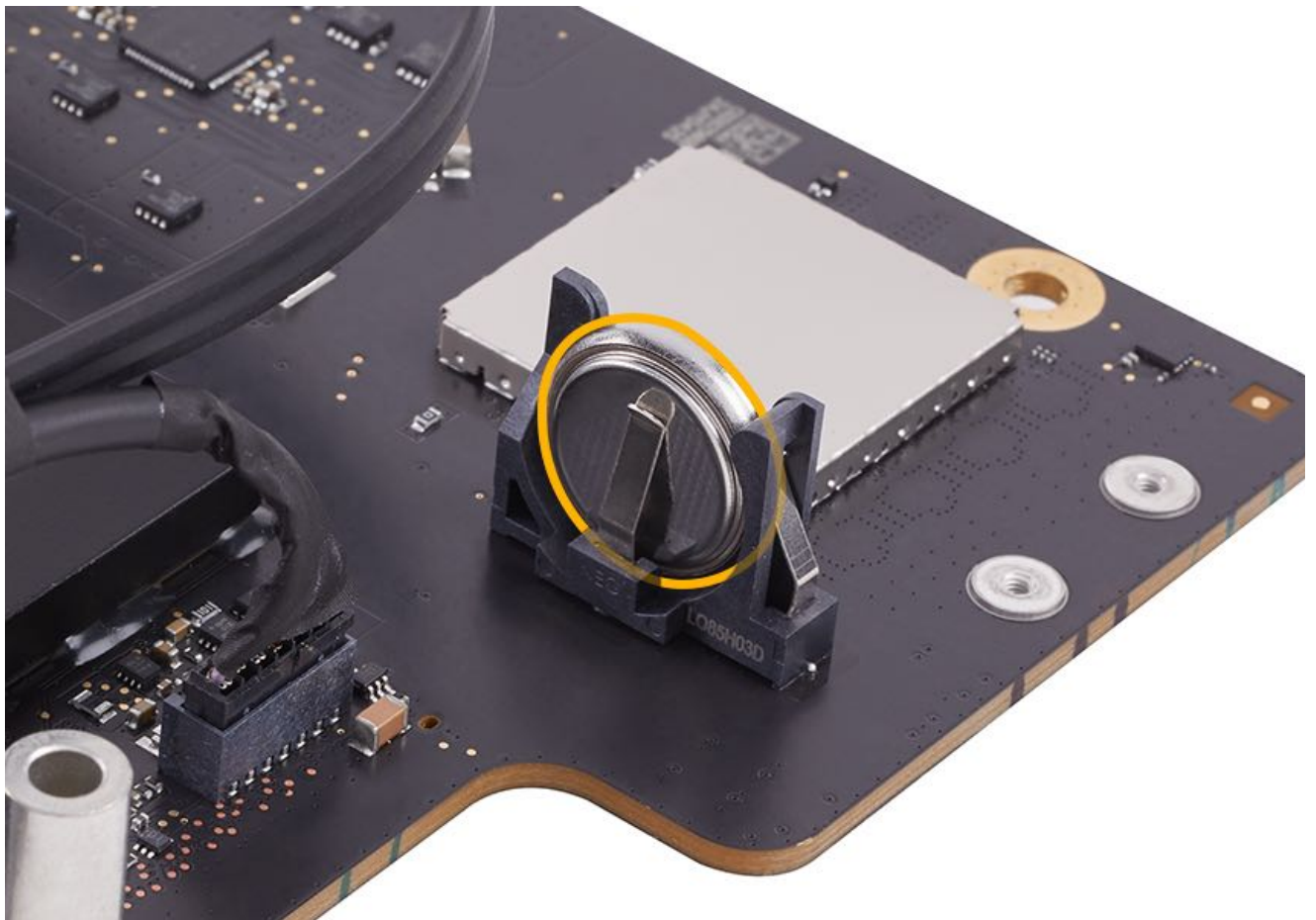


### Steps For Reassembly



**Warning!** If the battery is installed incorrectly or replaced by an incorrect battery, there is a risk of explosion. Dispose of used batteries according to local environmental laws and guidelines.

1. Check that the battery socket is open and free of dust.
2. Insert the battery into the socket with the negative side (no markings) facing the metal clip.



3. Reinstall the logic board for the model you are repairing:
  - [logic board](#) (2019)
  - [logic board](#) (2020)
4. Reinstall the [power supply](#).
5. Reinstall the [right speaker](#).
6. Reinstall the [hard drive](#) (2019 only).
7. Reinstall the [left speaker](#).
8. Reinstall the fan for the model you are repairing:
  - [fan](#) (2019)
  - [fan](#) (2020)
9. Reinstall the display for the model you are repairing:
  - [display reassembly](#) (2019)
  - [display reassembly](#) (2020)

**Note:** Effective immediately, some coin cell batteries used on Mac systems are now available only from electronics parts distributors (for example, MCM). If the coin battery needs to be replaced, please order it from an electronics parts distributor. BR2032 and CR2032 batteries have the same form factor and nominal voltage. However, BR2032 batteries have a lower self-discharge rate and broader operating temperature range than CR2032 batteries for longer shelf and service life.

# iMac (Retina 5K, 27-inch, 2019 and 2020) Bluetooth and Wi-Fi Antennas

## First Steps

### Caution:

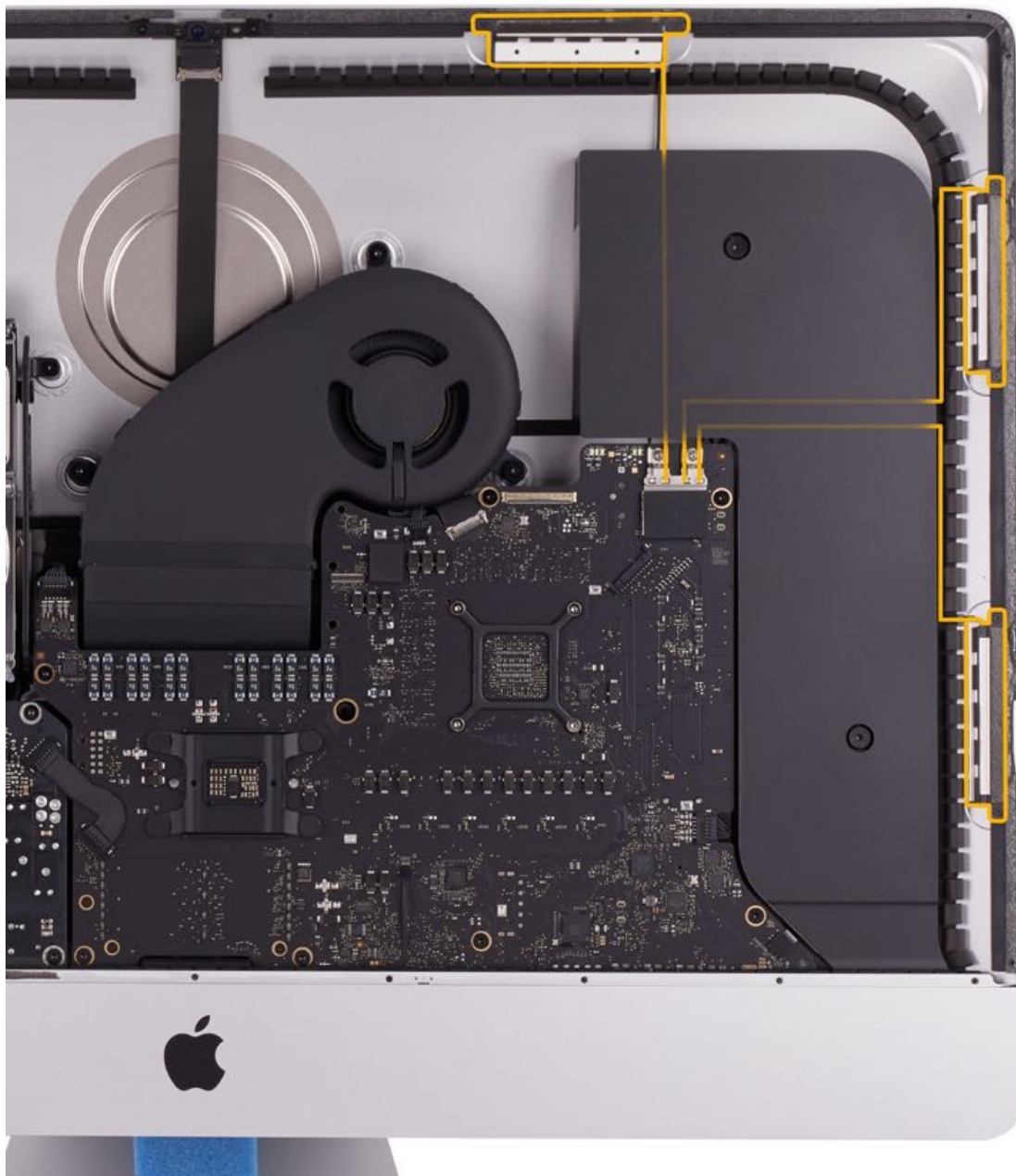
- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Note:

- Images in this procedure show the iMac (Retina 5K, 27-inch, 2019), but the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- Display
  - [Display removal](#) (2019)
  - [Display removal](#) (2020)
- [Right speaker](#)





## Tools

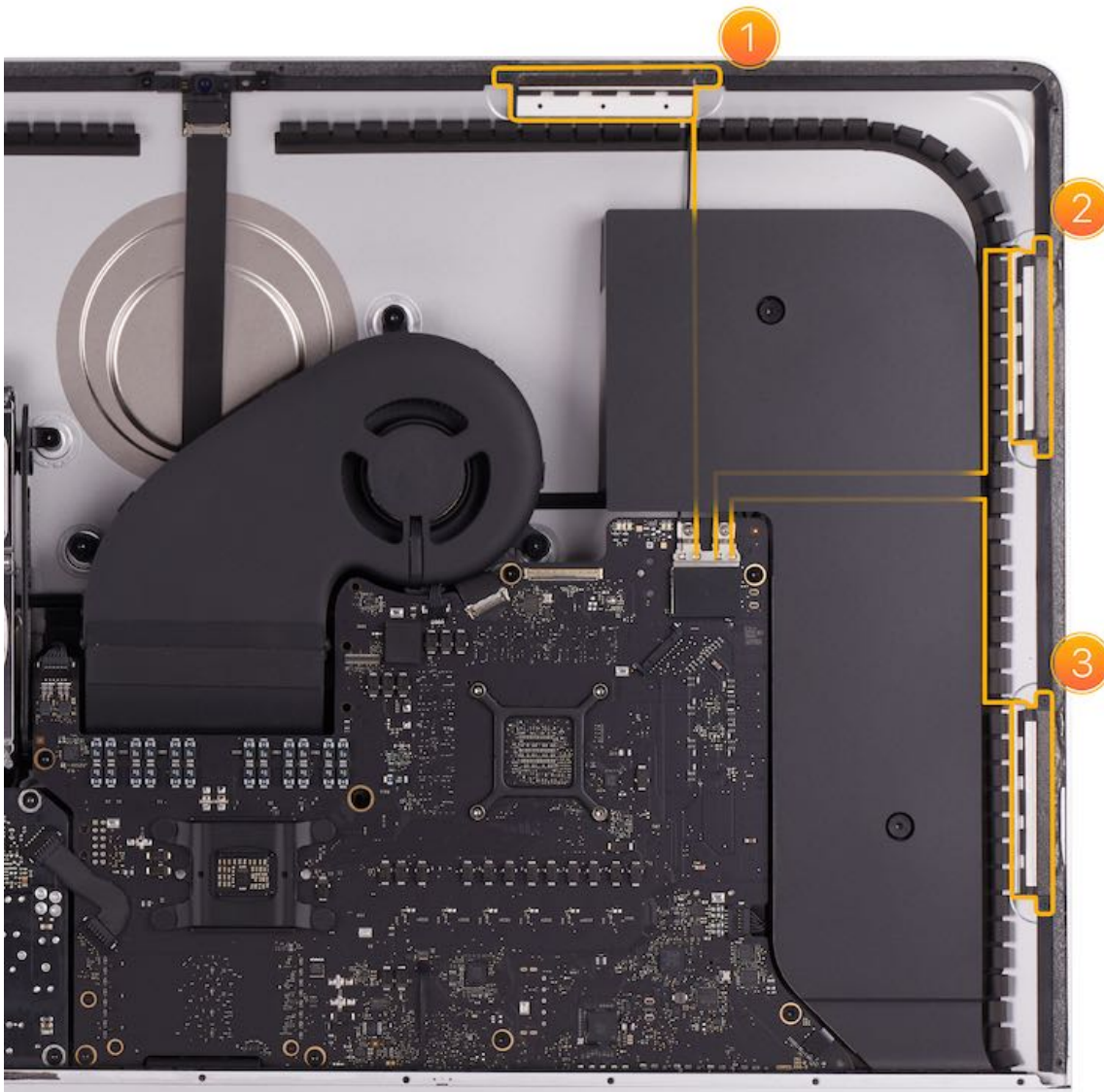
1. iMac service wedge
2. Torx T4 screwdriver
3. Torx T5 screwdriver
4. Antenna tool (923-01322)
5. Black stick
6. Wireless card support tool (923-03085)



## Steps For Removal

**Important:** The procedure is the same for all three antennas. Refer to the following image to determine the location and cable routing of the antenna you intend to replace.

- 1 = Bluetooth
- 2 = Middle Wi-Fi
- 3 = Lower Wi-Fi

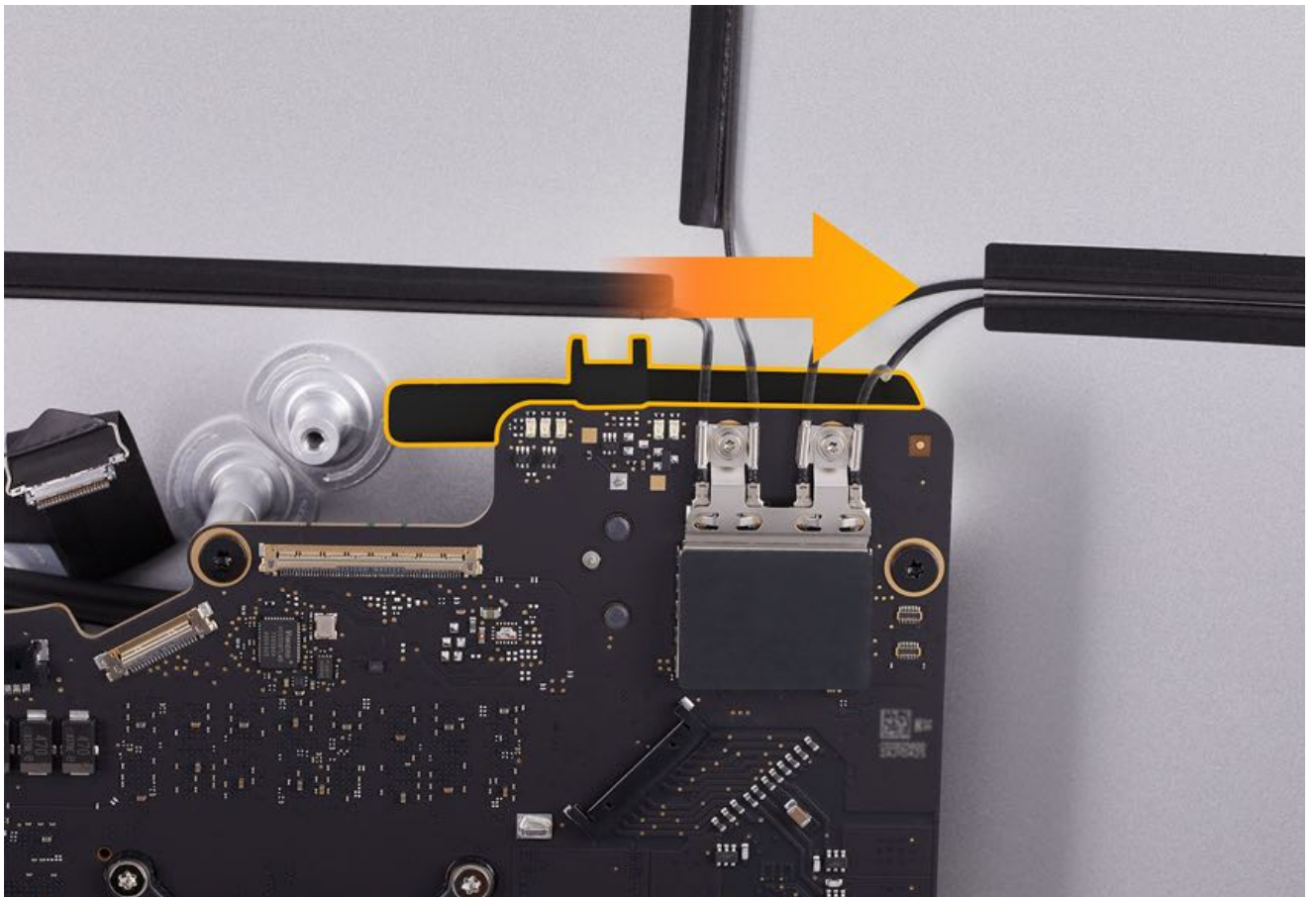




**Caution:** Avoid the coin cell battery when inserting the tool.

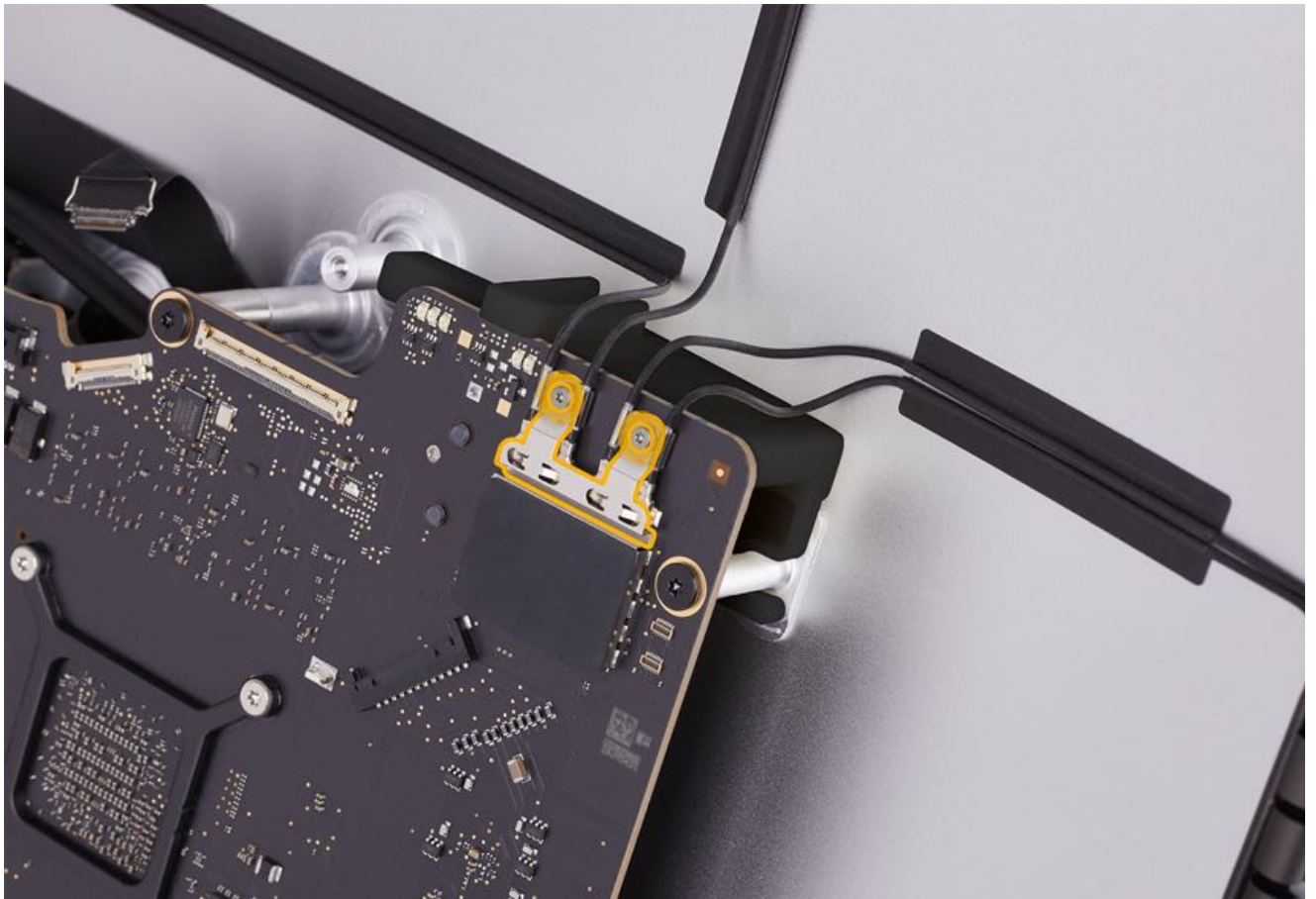


1. Grasp the wireless card support tool handle, lower the tool onto the logic board, and slide it behind the antenna connectors.

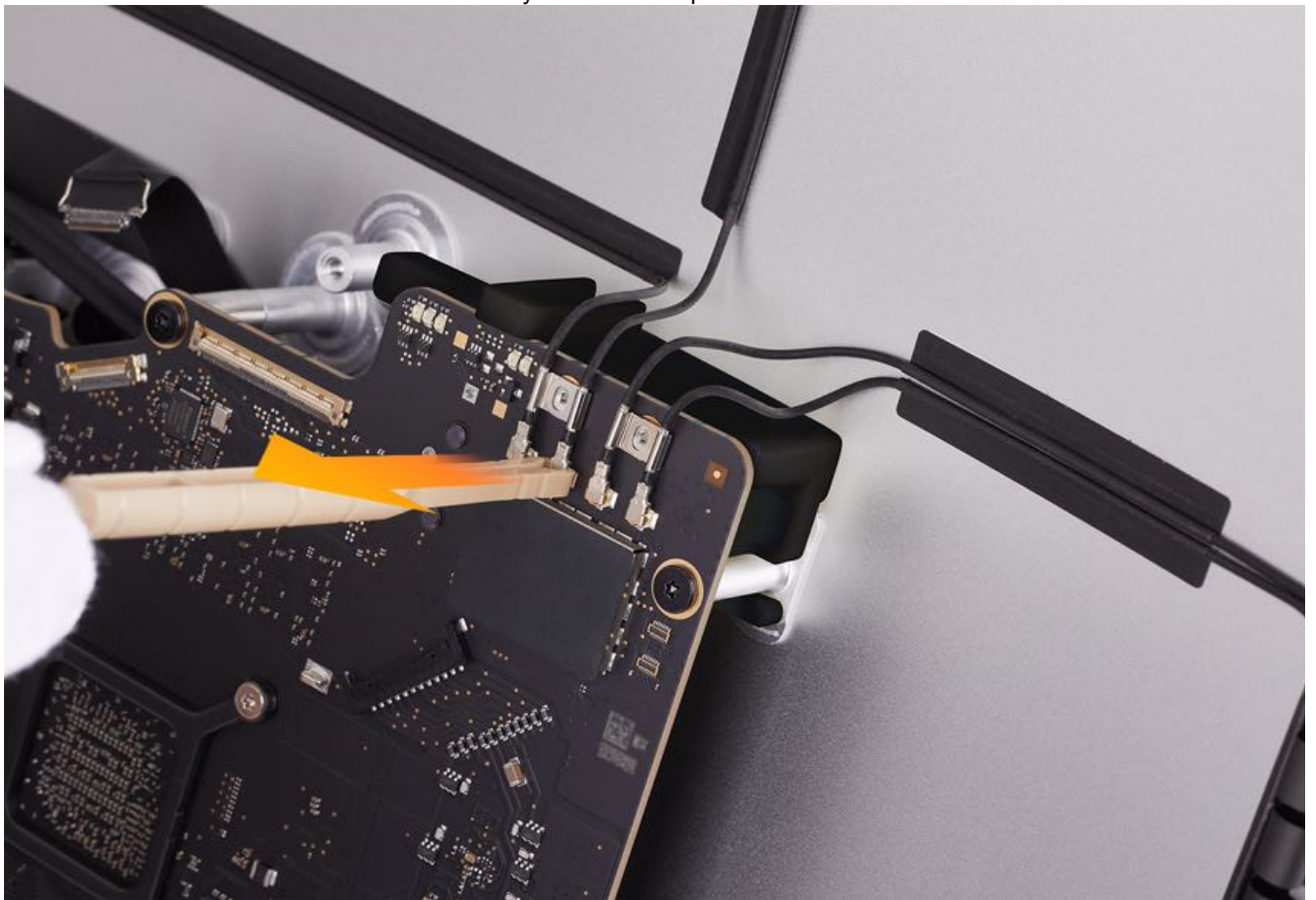


2. Remove the two T5 screws from the antenna cowling. Remove the antenna cowling and save it for reuse.

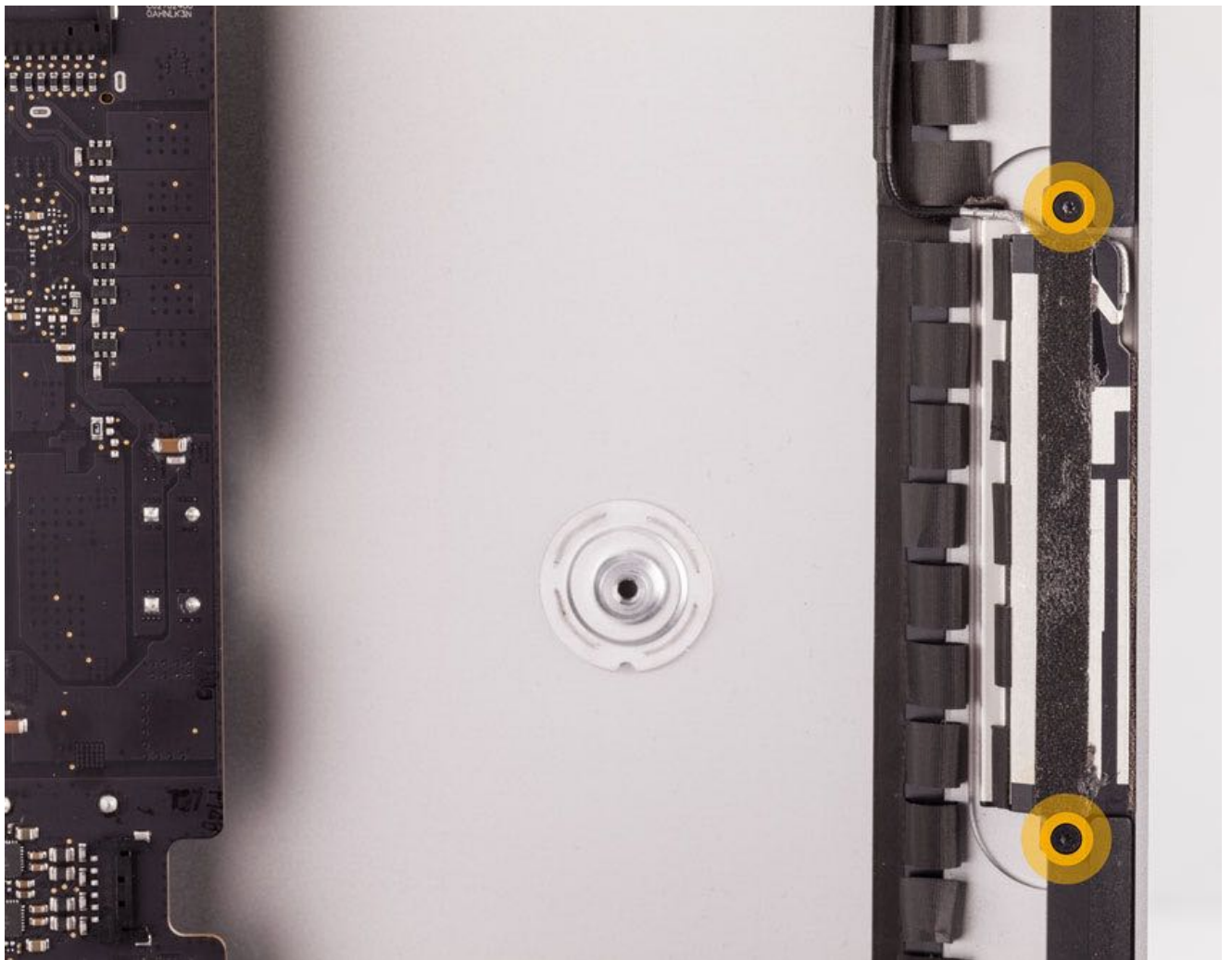




3. Use the antenna tool to disconnect the antenna you intend to replace.



4. Use a black stick or your fingers to gently remove the tape from the rear housing.
5. Remove the two T4 screws that secure the antenna body to the rear housing.



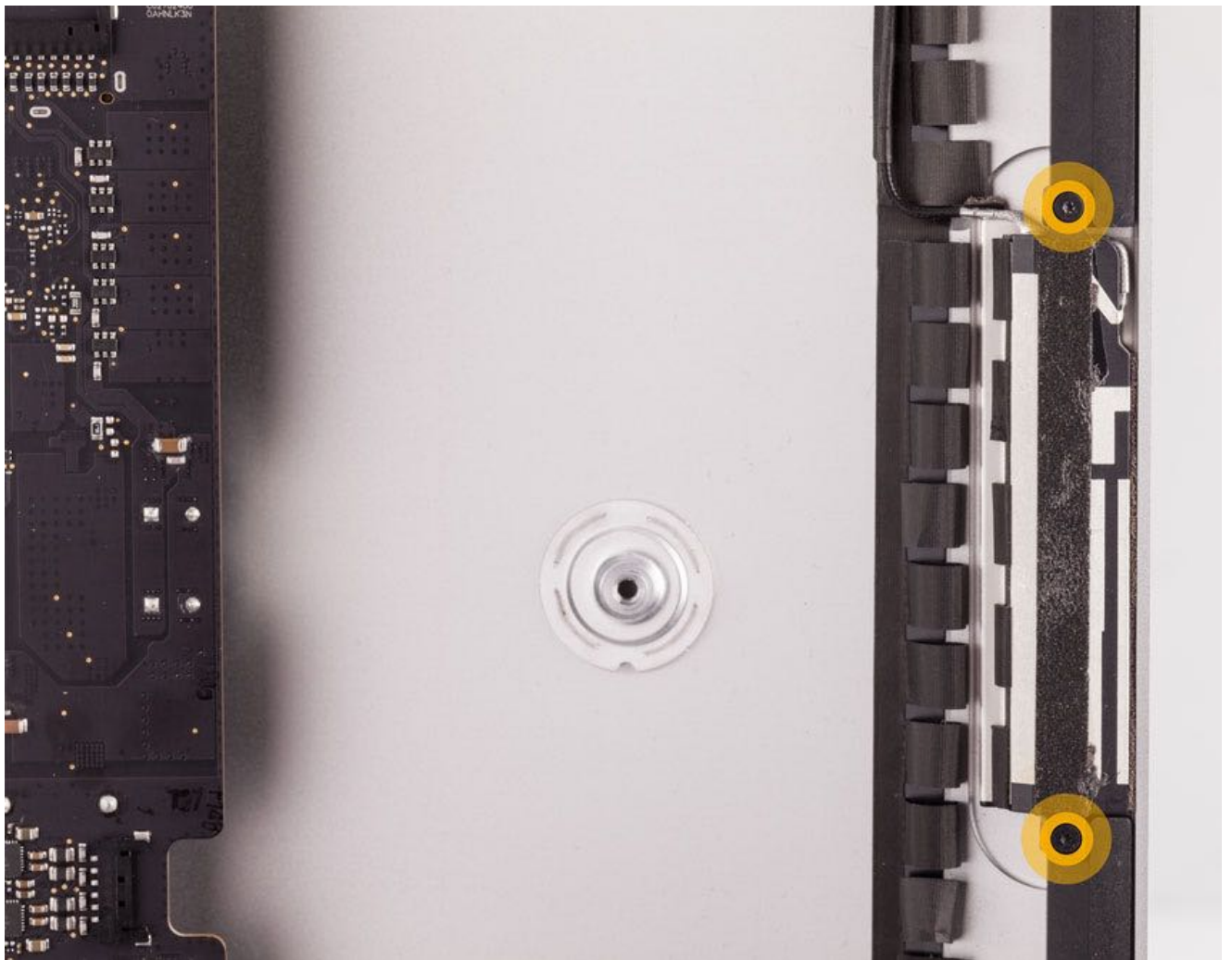
6. Remove the antenna from the rear housing.

### Steps For Reassembly

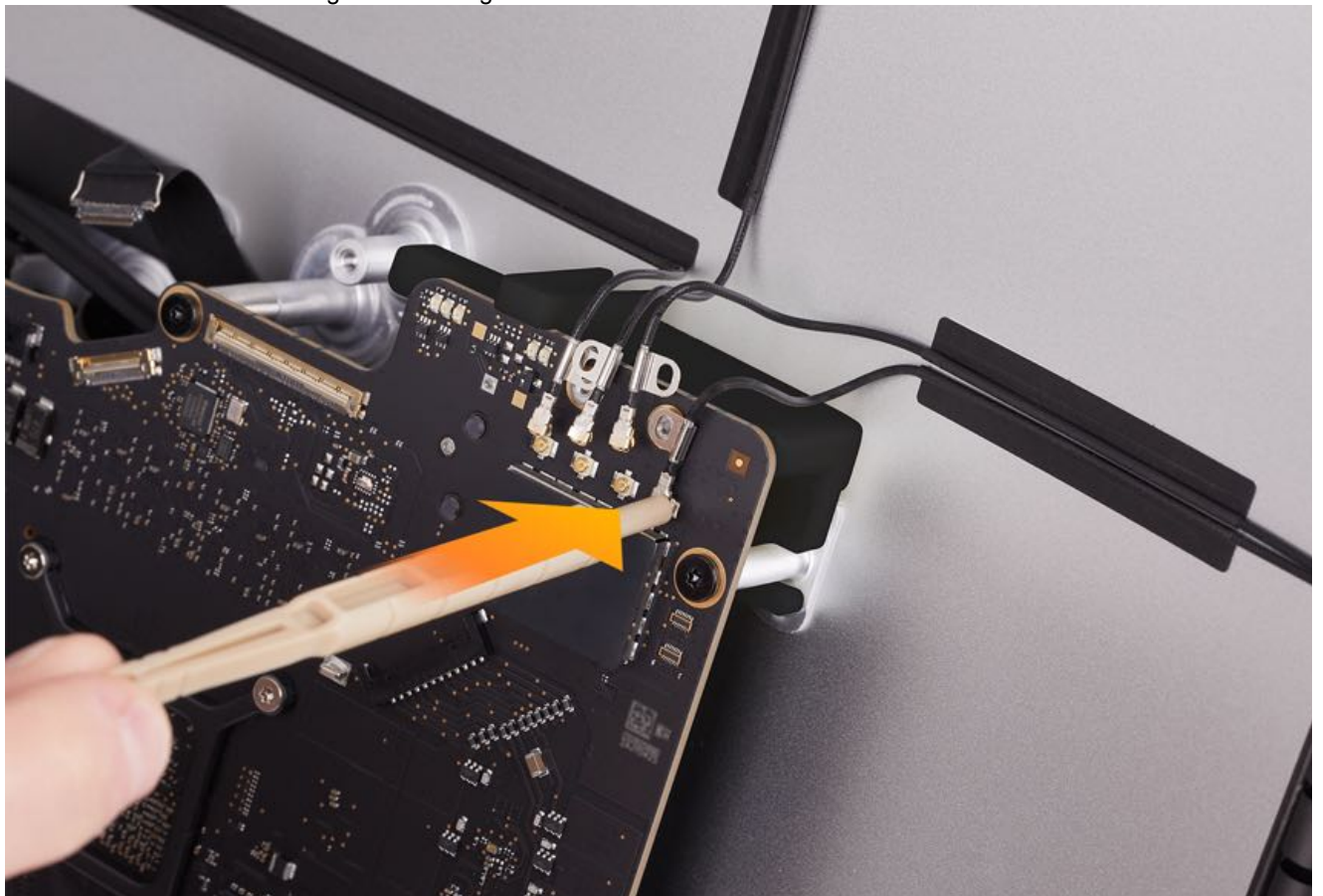
1. Reinstall two T4 screws (923-00831) to secure the antenna body to the rear housing.



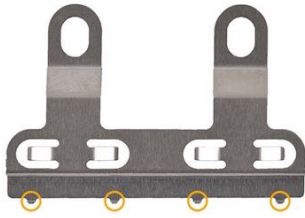




2. Route the antenna cable to the antenna connector on the logic board.
3. Adhere the antenna cable tape to the rear housing.
4. Connect the antenna to the logic board using the flat side of the antenna tool.



5. Insert the antenna cowling at an angle to engage the teeth in the slots. Then position the antenna cowling over the connectors to reinstall it.
  - Cowling: 923-02330



6. Reinstall the two T5 screws in the antenna cowling.
  - T5: 923-02294



7. Remove the wireless card support tool.



8. Check the airloop gasket and use a black stick or tweezers to open any flattened loops.
9. Reinstall the [right speaker](#).
10. Reinstall the display for the model you are repairing to complete reassembly:
  - [display reassembly](#) (2019)
  - [display reassembly](#) (2020)



# iMac (Retina 5K, 27-inch, 2020) Rear Microphone Cable

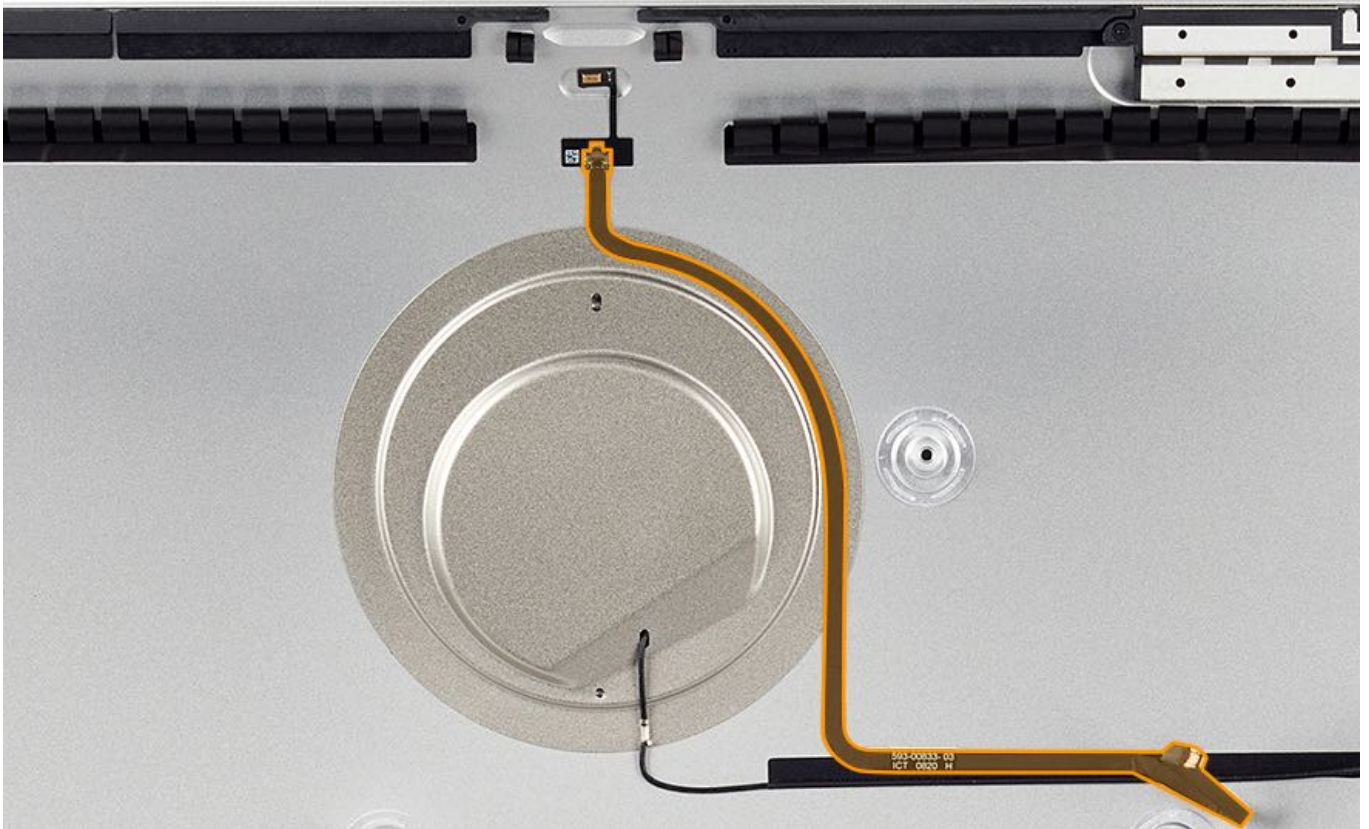
## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- [Display](#)
- [Fan](#)



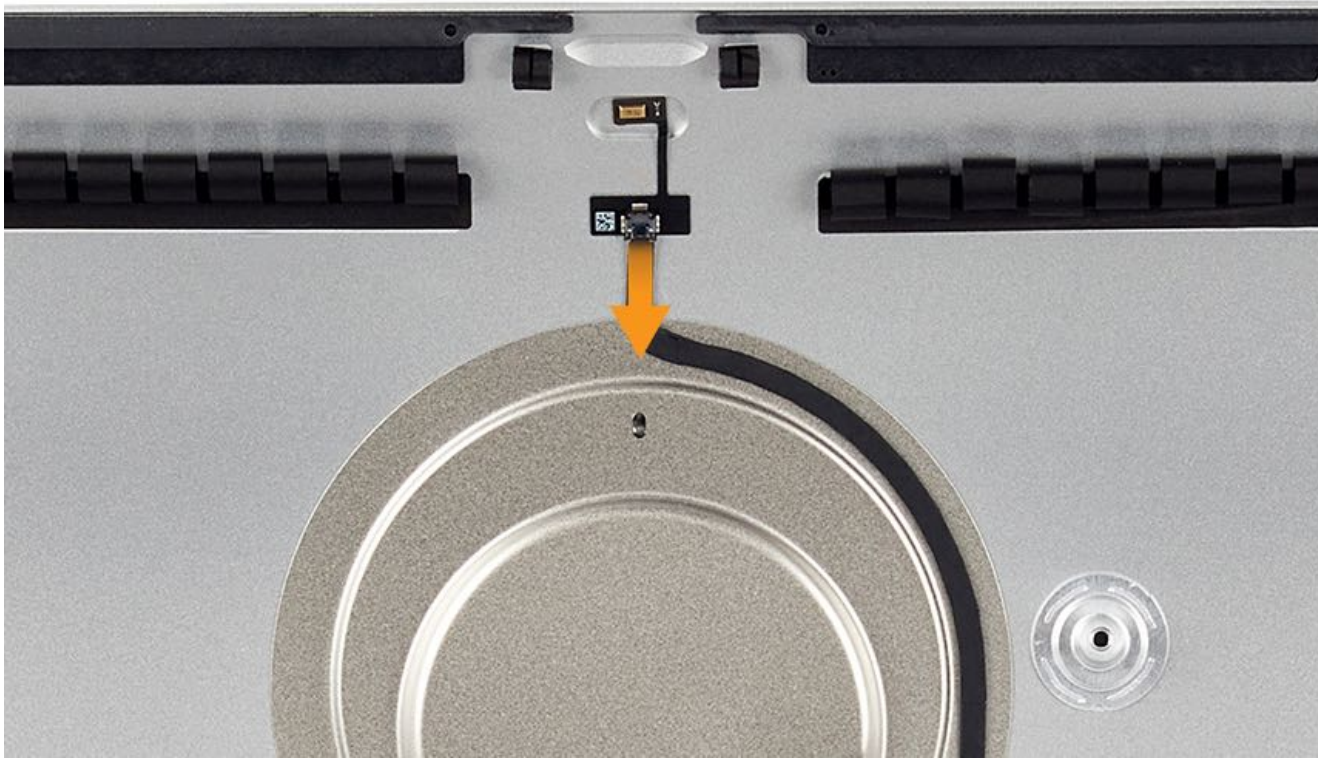
## Tools

1. Black stick
2. iMac service wedge

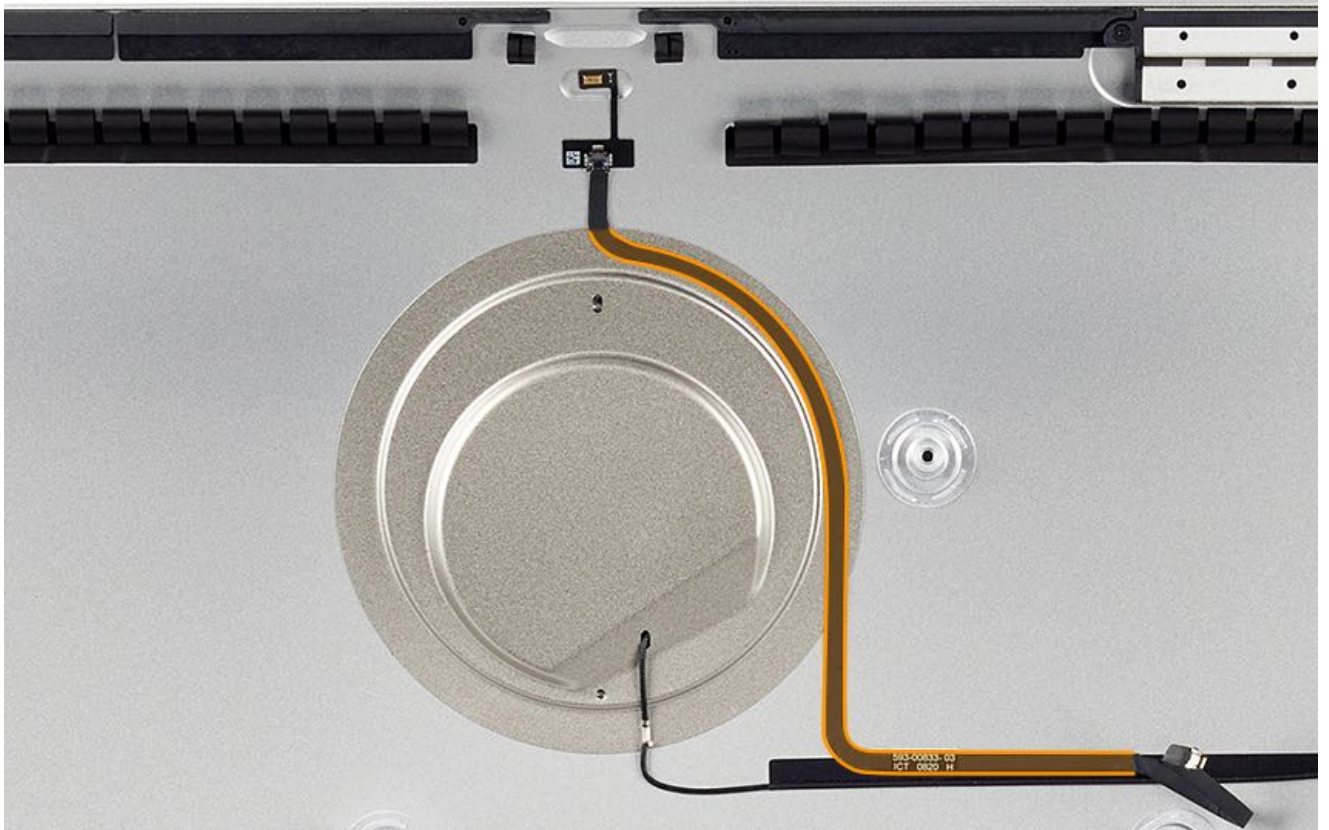


## Steps For Removal

1. Gently pull the rear microphone cable out of the microphone connector in the rear housing.



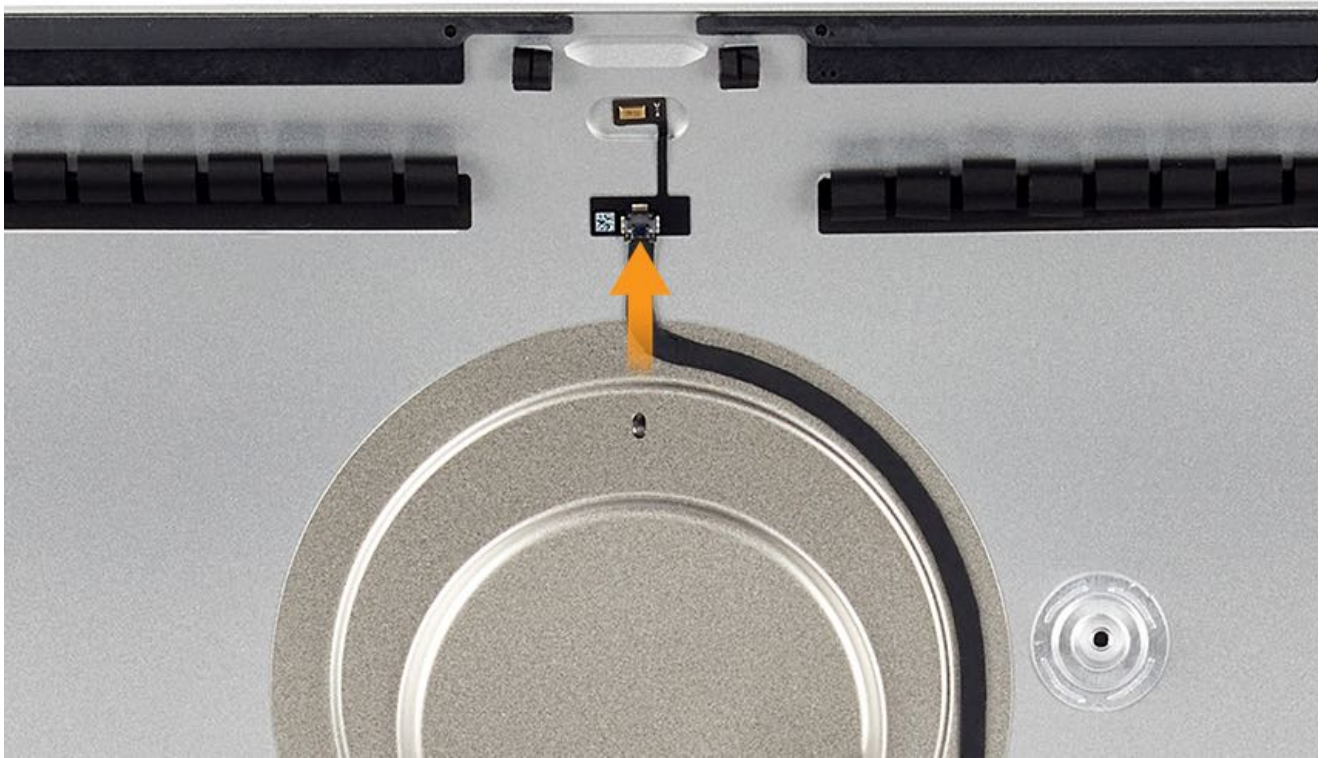
2. Use a blackstick to gently separate the adhesive bond between the rear microphone cable and rear housing, then remove the rear microphone cable.



### Steps For Reassembly

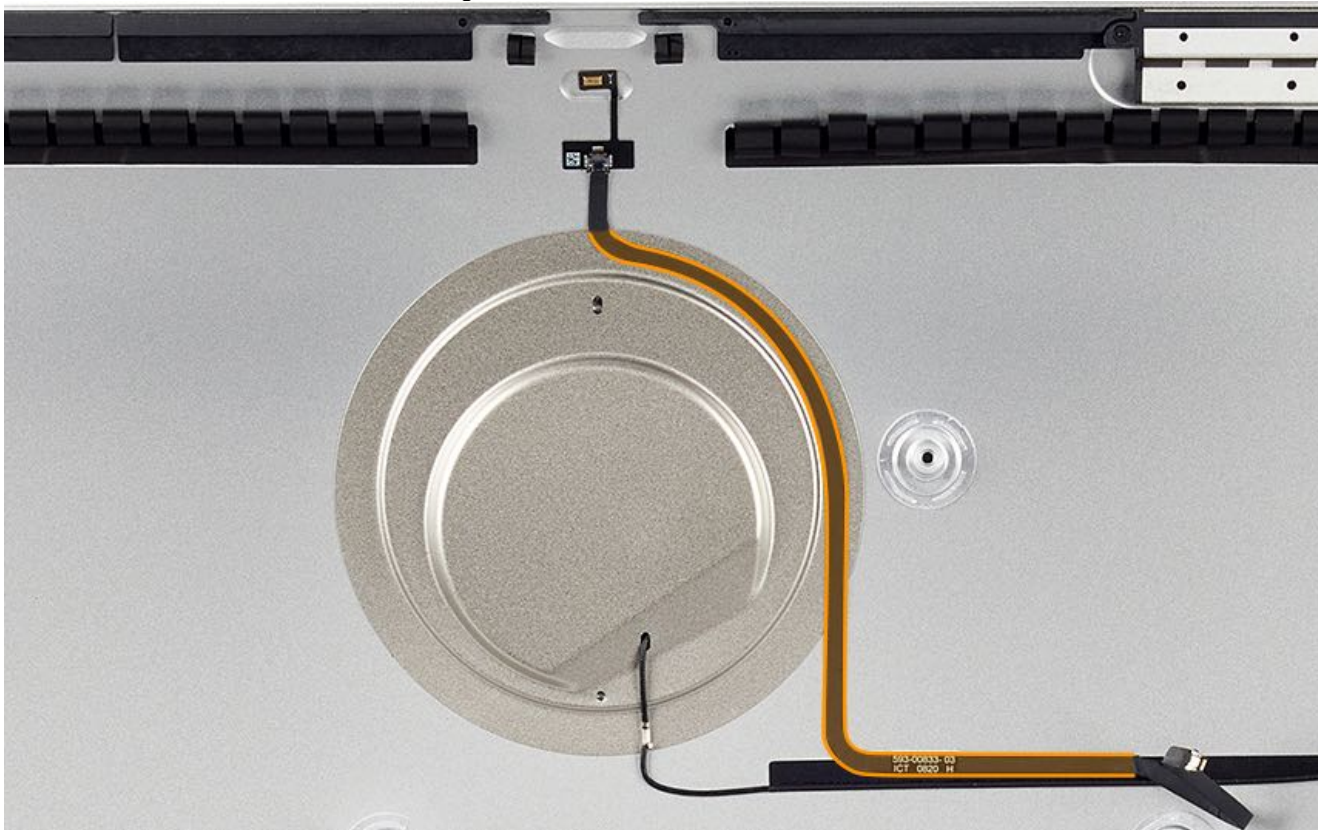
1. Connect the rear microphone cable to the microphone connector in the rear housing.





2. Adhere the rear microphone cable to the rear housing as shown in the image below.

**Note:** If installing a replacement rear microphone cable, first remove the adhesive backing, then press along the length of the cable to adhere it to the rear housing.



3. Reinstall the [fan](#).
4. Reinstall the [display](#) to complete reassembly.

# iMac (Retina 5K, 27-inch, 2019 and 2020) Stand

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

- Images in this procedure show the iMac (Retina 5K, 27-inch, 2019), but the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- Display
  - [Display removal](#) (2019)
  - [Display removal](#) (2020)
- Fan
  - [Fan](#) (2019)
  - [Fan](#) (2020)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#) (2019 only)
- [Power supply](#)
- Logic board
  - [Logic board](#) (2019)
  - [Logic board](#) (2020)



## Tools

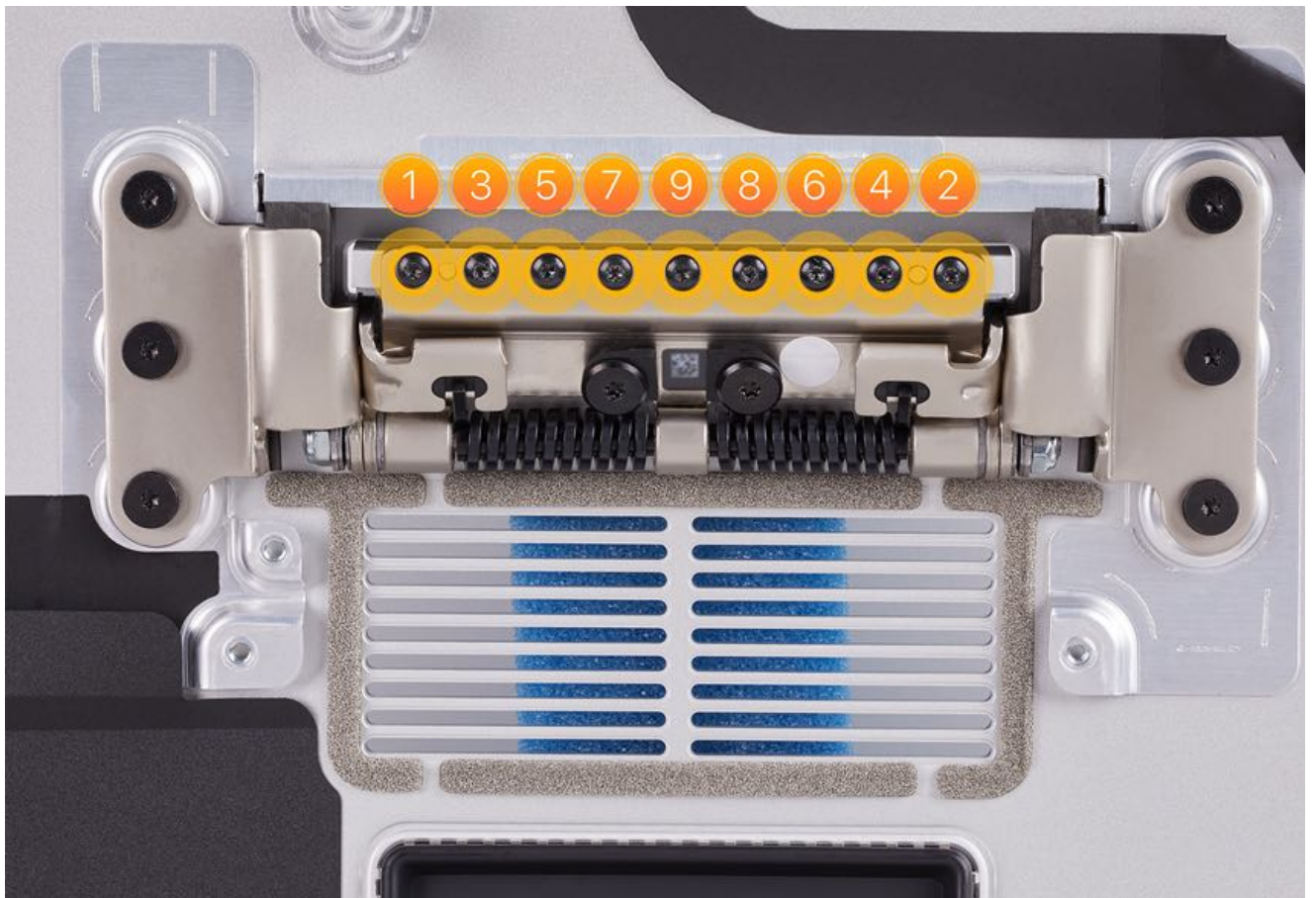
1. Torx T8 screwdriver
2. iMac service wedge



## Steps For Removal

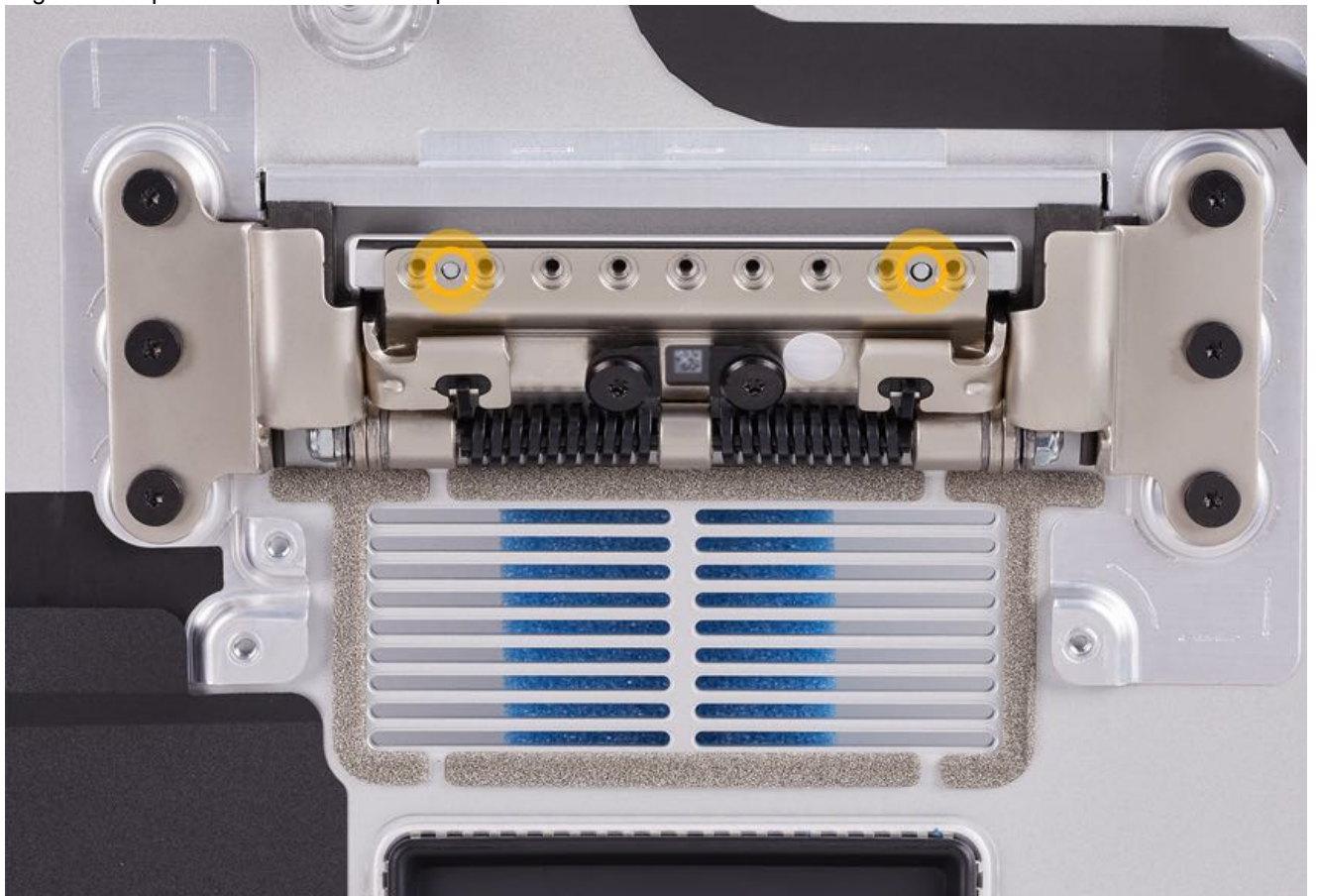
1. Remove nine T8 screws in the order shown in the image.
2. Lift the rear housing off of the stand.





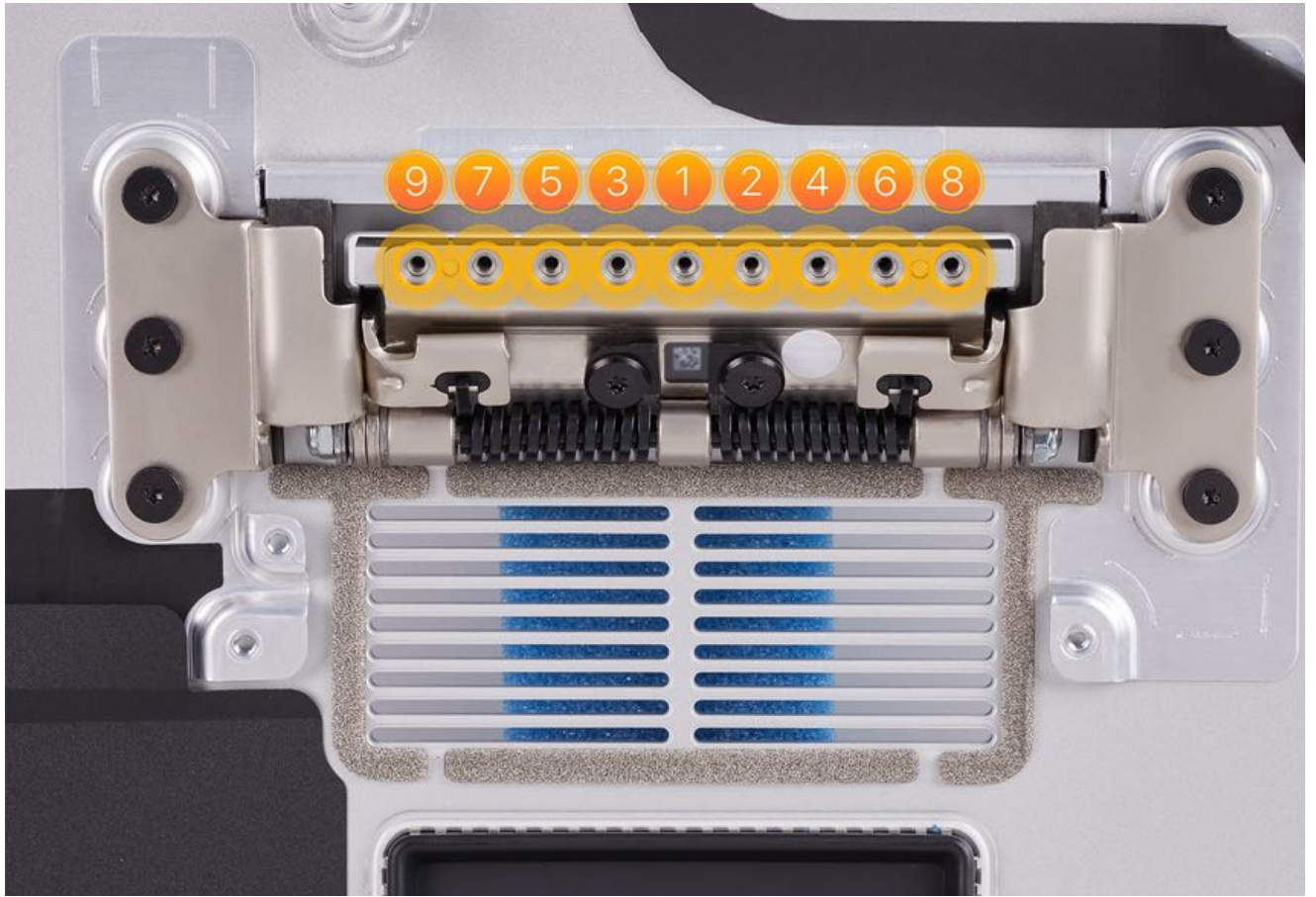
### Steps For Reassembly

1. Align the two pins on the stand with the pin holes on the mechanism.



2. Reinstall the nine T8 screws (923-00529) in the order shown in the image.





3. Reinstall the logic board for the model you are repairing:
  - [logic board](#) (2019)
  - [logic board](#) (2020)
4. Reinstall the [power supply](#).
5. Reinstall the [right speaker](#).
6. Reinstall the [hard drive](#) (2019 only).
7. Reinstall the [left speaker](#).
8. Reinstall the fan for the model you are repairing:
  - [fan](#) (2019)
  - [fan](#) (2020)
9. Reinstall the display for the model you are repairing:
  - [display reassembly](#) (2019)
  - [display reassembly](#) (2020)

# iMac (Retina 5K, 27-inch, 2019 and 2020) Mechanisms

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Important:

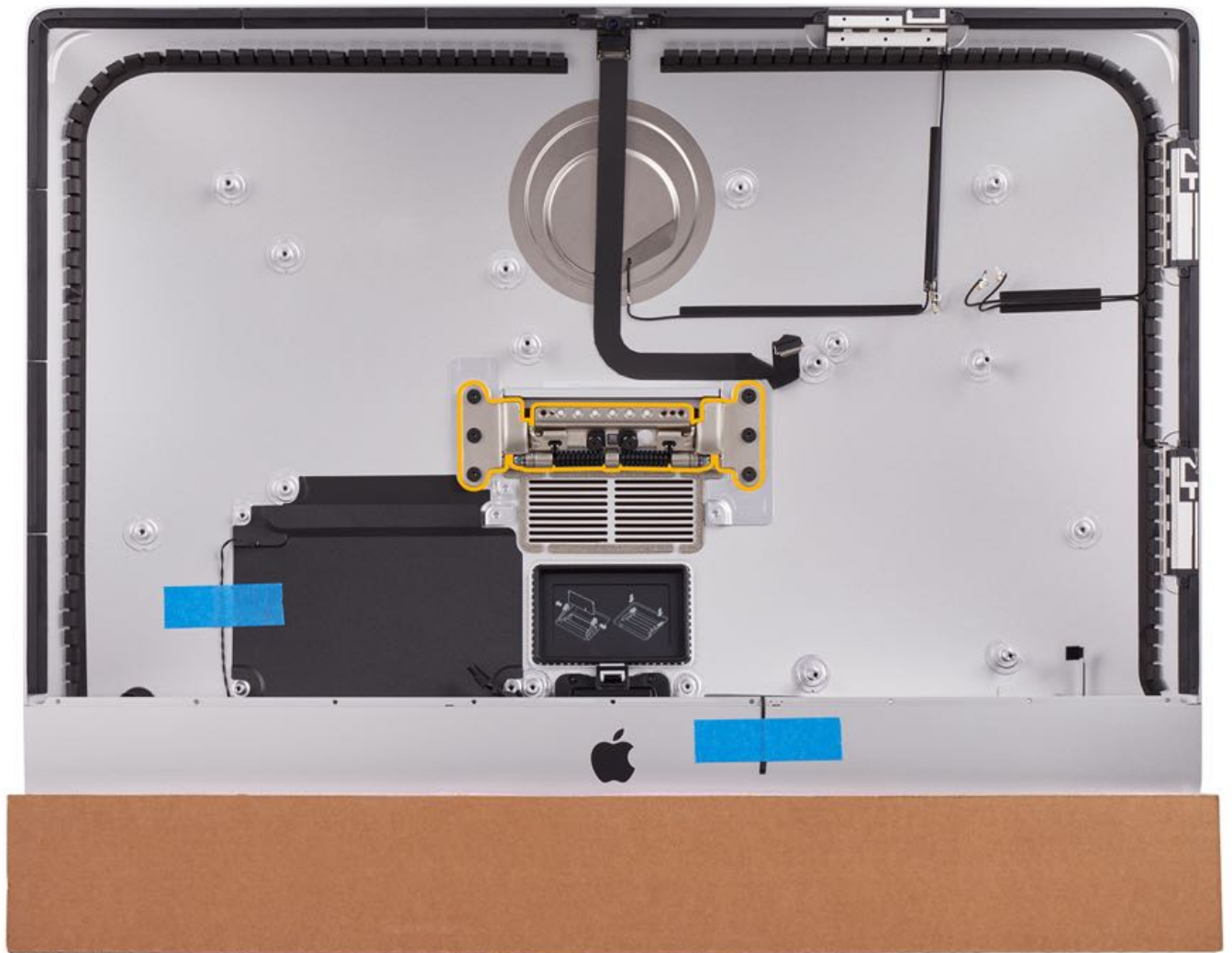
- Images in this procedure show the iMac (Retina 5K, 27-inch, 2019), but the steps to perform the repair are the same for iMac (Retina 5K, 27-inch, 2020).

### Remove:

- Display
  - [Display removal](#) (2019)
  - [Display removal](#) (2020)
- Fan
  - [Fan](#) (2019)
  - [Fan](#) (2020)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#) (2019 only)
- [Power supply](#)
- Logic board
  - [Logic board](#) (2019)
  - [Logic board](#) (2020)
- [Stand](#) (stand mechanism only)

This article includes removal and reassembly steps for the mechanism and the memory door lock mechanism.

### Stand Mechanism:



**Memory Door Lock Mechanism:**



## Tools

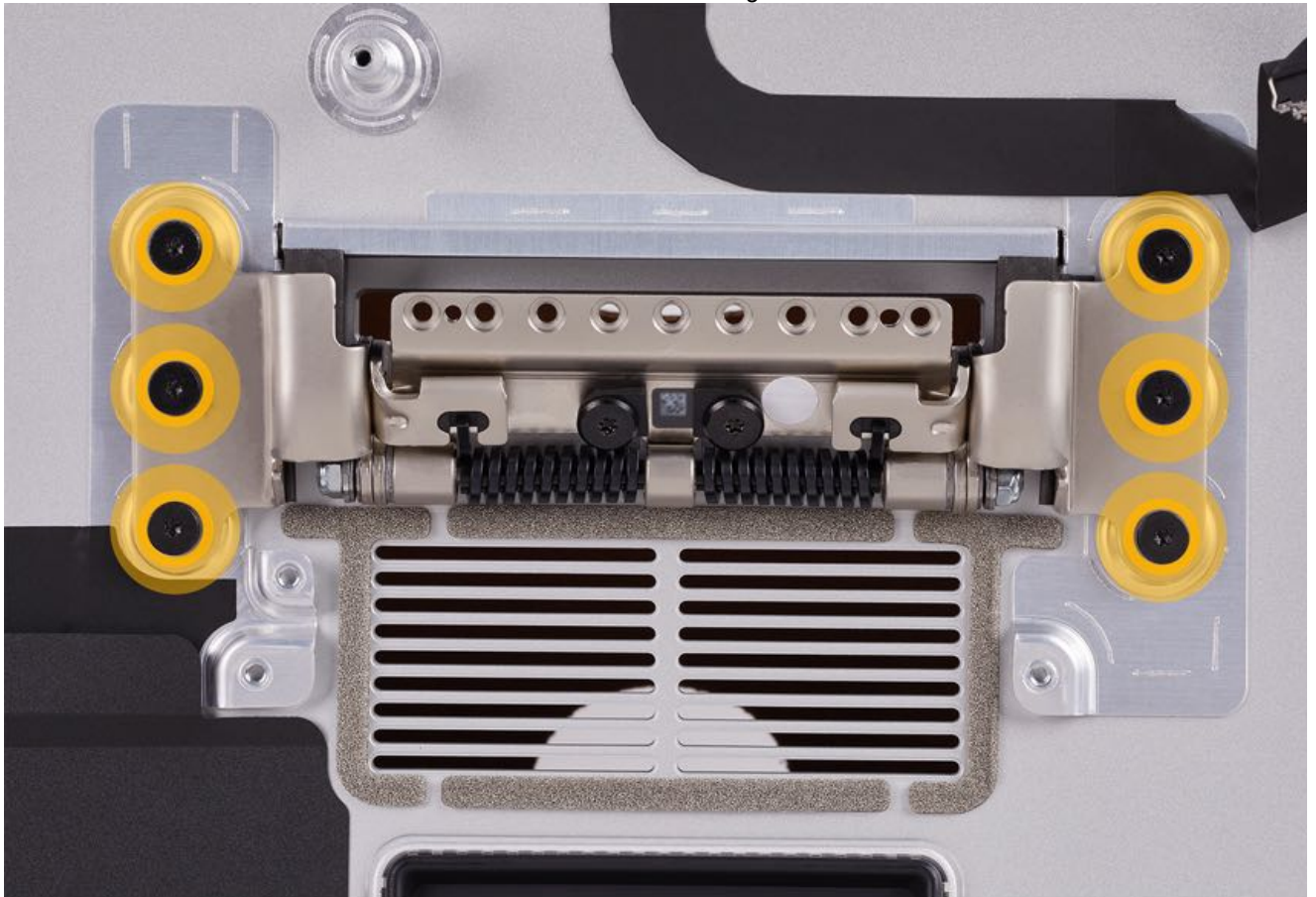
1. Torx T5 screwdriver
2. Torx T10 screwdriver
3. LCD service support stand (923-0416)



## Steps For Removal

### Stand Mechanism:

1. Place the rear housing in the display support stand.
2. Remove six T10 screws and lift the mechanism off of the rear housing.



### Memory Door Lock Mechanism:

1. Remove four T5 screws from the memory door lock mechanism and lift it off of the rear housing.





## Steps For Reassembly

### Stand Mechanism:

1. Position the mechanism in the center of the rear housing.
2. Reinstall the six T10 (923-0334) screws in the order shown in the image.







**Memory Door Lock Mechanism:**

1. Position the memory door lock mechanism in the rear housing.
2. Reinstall the four T5 (923-0404) screws in the lock mechanism.





**Reinstall the following parts to complete reassembly:**

3. Reinstall the [stand](#).
4. Reinstall the logic board for the model you are repairing:
  - [logic board](#) (2019)
  - [logic board](#) (2020)
5. Reinstall the [power supply](#).
6. Reinstall the [right speaker](#).
7. Reinstall the [hard drive](#) (2019 only).
8. Reinstall the [left speaker](#).
9. Reinstall the fan for the model you are repairing:
  - [fan](#) (2019)
  - [fan](#) (2020)
10. Reinstall the display for the model you are repairing:
  - [display reassembly](#) (2019)
  - [display reassembly](#) (2020)

# iMac (Retina 5K, 27-inch, 2019 and 2020) Rear Housing

## First Steps

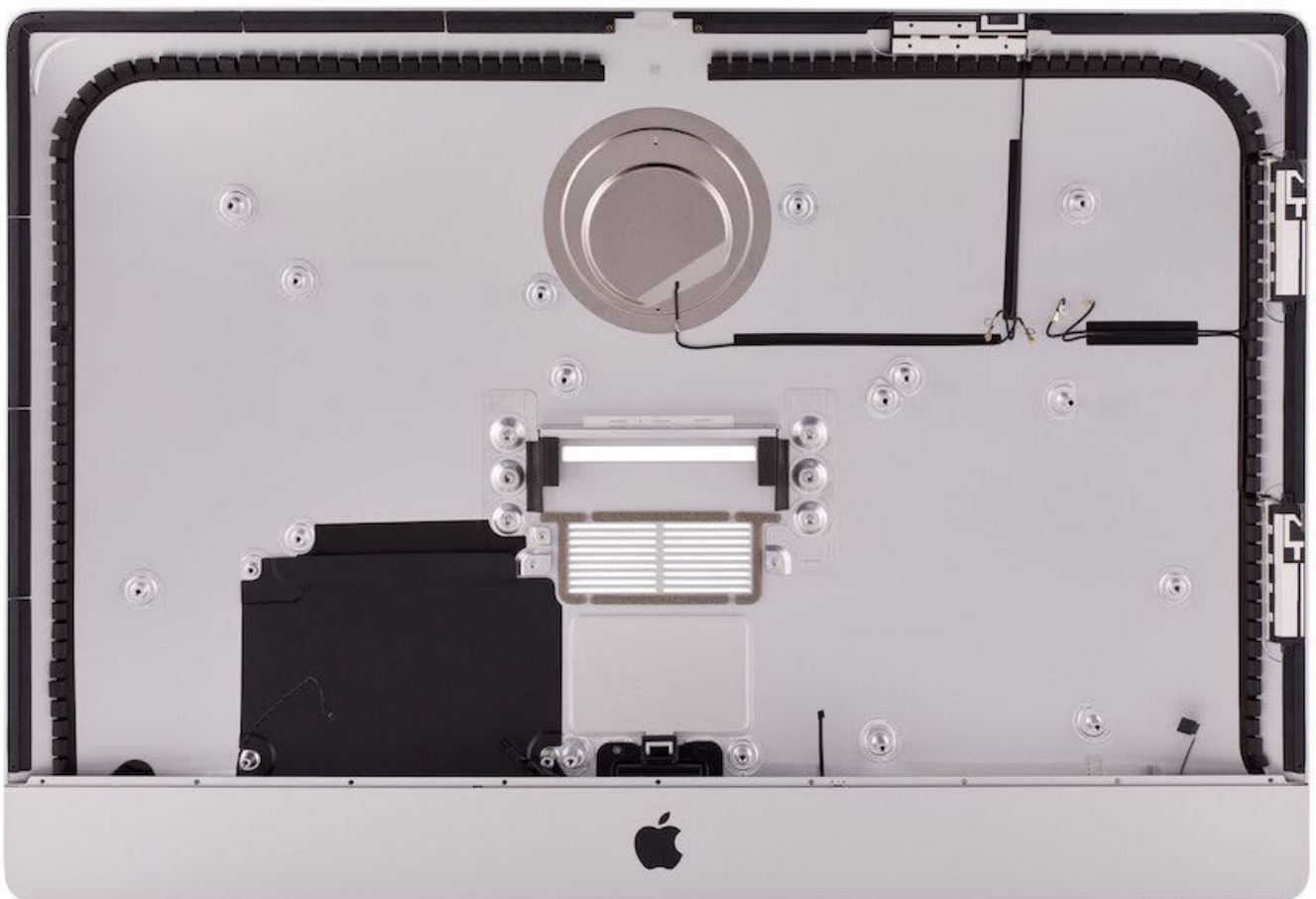
### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

### Remove:

- Display
  - [Display removal](#) (2019)
  - [Display removal](#) (2020)
- [Camera](#) (2019 only)
- Fan
  - [Fan](#) (2019)
  - [Fan](#) (2020)
- [Left speaker](#)
- [Right speaker](#)
- [Hard drive](#) (2019 only)
- [Power supply](#)
- Logic board
  - [Logic board](#) (2019)
  - [Logic board](#) (2020)
- [Antennas](#)
- [Rear microphone cable](#) (2020 only)
- [Stand](#)
- [Mechanism](#)

**Note:** After you have removed the parts listed above, the rear housing is the only remaining part.



## Tools

1. Anti-static, lint-free cloth
2. Torx T25 screwdriver



## Steps For Removal

**Caution:** Place the rear housing on a soft cloth to avoid scratching.

### iMac (Retina 5K, 27-inch, 2019):

- The rear housing includes the following removable parts, which are available separately:
  - Chin strap (923-01671) and screws (923-0338)
  - Mechanism (923-03066) and screws (923-0334)
  - Memory cover (923-03069)
  - Memory cover lock mechanism (923-01735) and screws (923-0404)
  - T25 hard drive bracket standoff screw (923-0521)
  - T25 power supply standoff screw (923-0520)
- The rear housing includes the following nonremovable parts, which are not available separately:
  - AC inlet
  - Airloop gasket
  - Audio board and flex cable
  - Chin microphone flex cable
  - Power button and cable
  - Wi-Fi antenna (in silver circle behind Apple logo)

### iMac (Retina 5K, 27-inch, 2020):

- The rear housing includes the following removable parts, which are available separately:
  - Chin strap (923-04228) and screws (923-0338)
  - Mechanism (923-03066) and screws (923-0334)
  - Memory cover (923-03069)
  - Memory cover lock mechanism (923-01735) and screws (923-0404)
  - Rear Microphone Cable (923-04723)
  - T25 power supply standoff screw (923-0520), use when there is no rear housing bracket
  - **Important:** Some models include a rear housing bracket (923-03444)
    - T25 bracket standoff screw (923-0521), use when a rear housing bracket is installed
- The rear housing includes the following nonremovable parts, which are not available separately:
  - AC inlet
  - Airloop gasket
  - Audio board and flex cable
  - Dual microphone flex cable
  - Power button and cable
  - Rear microphone
  - Wi-Fi antenna (in silver circle behind Apple logo)

## Steps For Reassembly

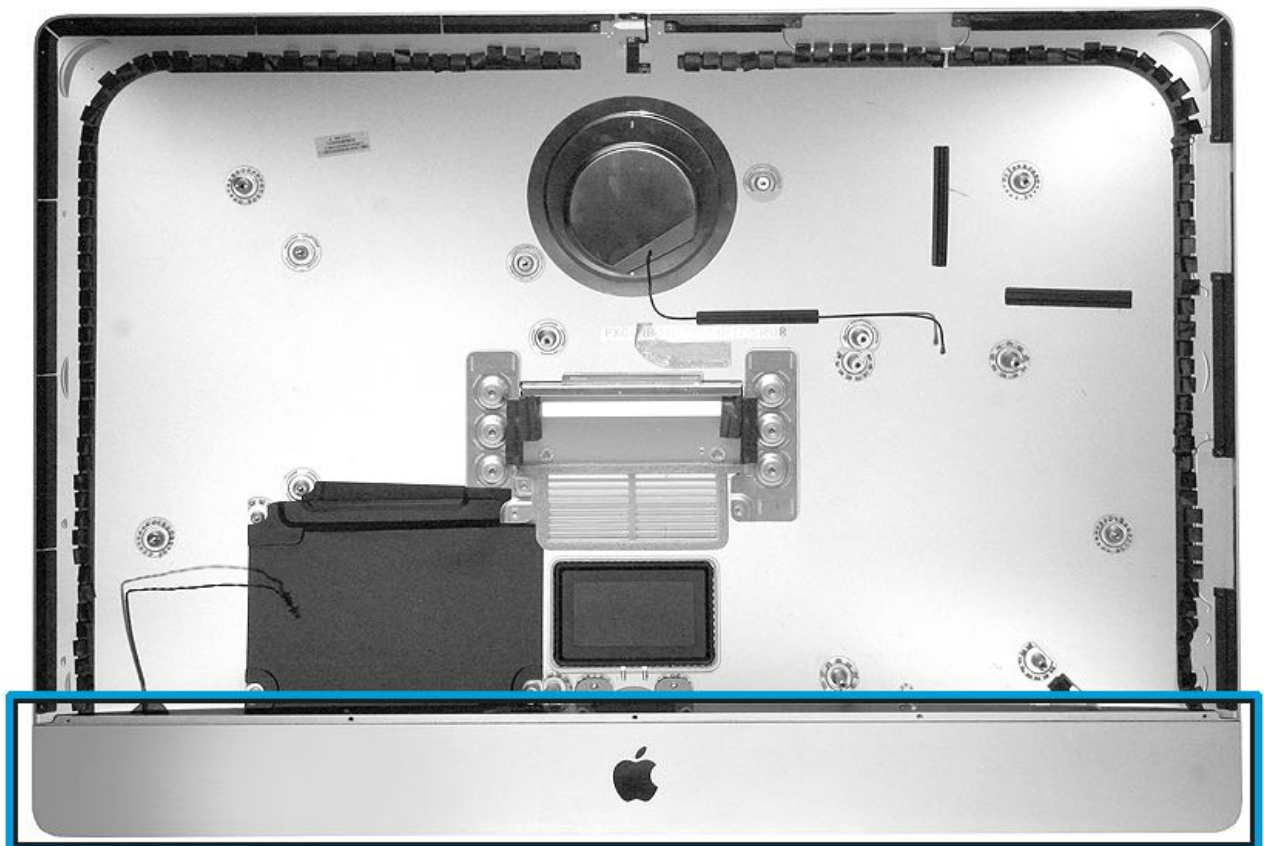
1. If you are replacing the rear housing, transfer the following parts:



- For iMac (Retina 5K, 27-inch, 2019):
    - Right hard drive bracket
    - T25 hard drive bracket standoff screw (923-0521)
    - T25 power supply standoff screw (923-0520)
  - For iMac (Retina 5K, 27-inch, 2020) without a rear housing bracket:
    - T25 power supply standoff screw (923-0520)
  - For iMac (Retina 5K, 27-inch, 2020) with a rear housing bracket:
    - Rear housing bracket (923-03444)
    - T25 bracket standoff screw (923-0521)
2. Reinstall the [mechanism](#).
  3. Reinstall the [stand](#).
  4. Reinstall the [rear microphone cable](#) (2020 only).
  5. Reinstall the [antennas](#). Route the antennas under the insulator tape or Mylar tape.  
**Note:** If the insulator tape or Mylar tape no longer adheres to the rear housing, use Kapton tape to secure the antennas.
  6. Reinstall the logic board for the model you are repairing:
    - [logic board](#) (2019)
    - [logic board](#) (2020)
  7. Reinstall the [power supply](#).
  8. Reinstall the [right speaker](#).
  9. Reinstall the [hard drive](#) (2019 only).
  10. Reinstall the [left speaker](#).
  11. Reinstall the fan for the model you are repairing:
    - [fan](#) (2019)
    - [fan](#) (2020)
  12. Reinstall the [camera](#) (2019 only).
  13. Reinstall the display for the model you are repairing:
    - [display reassembly](#) (2019)
    - [display reassembly](#) (2020)



**Caution:** Always handle the rear housing with two hands: one hand on the lower left corner and one hand on the lower right corner. Incorrectly handling the rear housing could bend the aluminum and cause alignment issues.





# iMac (2019 and 2020) Built-in VESA Mount Adapter

## First Steps

### Caution:

- Only [Apple-certified technicians](#) (OP1859) should perform this procedure.
- Wear an ESD wrist strap and [take precautions to avoid ESD](#) (OP100).

**Note:** You don't need to remove any internal parts if you are servicing the VESA mount adapter or VESA tongue. They are located on the back of the rear housing.

Only remove the following parts if you need to service the VESA mechanism plate or VESA rear housing:

#### iMac (Retina 4K, 21.5-inch, 2019)

[Display](#)  
[Fan](#)  
[Hard Drive](#)  
[Left Speaker](#)  
[Right Speaker](#)  
[Power Supply](#)  
[Logic Board](#)

#### iMac (Retina 5K, 27-inch, 2019)

[Display](#)  
[Fan](#)  
[Left Speaker](#)  
[Right Speaker](#)  
[Hard Drive](#)  
[Power Supply](#)  
[Logic Board](#)

#### iMac (Retina 5K, 27-inch, 2020)

[Display](#)  
[Fan](#)  
[Left Speaker](#)  
[Right Speaker](#)  
[Power Supply](#)  
[Logic Board](#)

## Tools

1. VESA pentalobe driver (923-0367)
2. Torx T8 screwdriver
3. Torx T10 screwdriver
4. iMac LCD service support stand (923-0416)

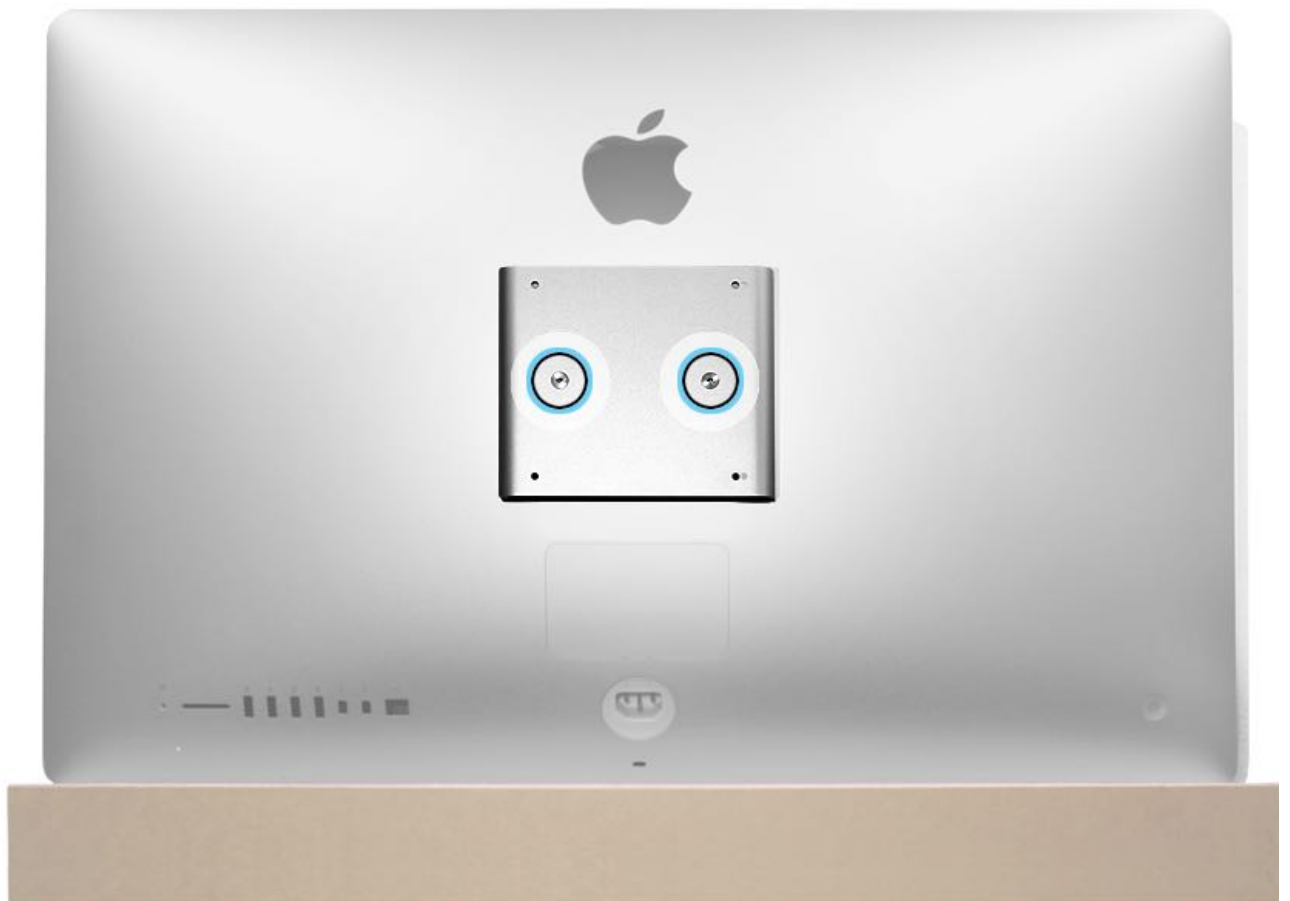


## Steps For Removal

### VESA Mount Adapter and VESA Tongue

**Note:** The VESA mount adapter and VESA tongue are located on the back of the rear housing. Both can be serviced without removing any parts.

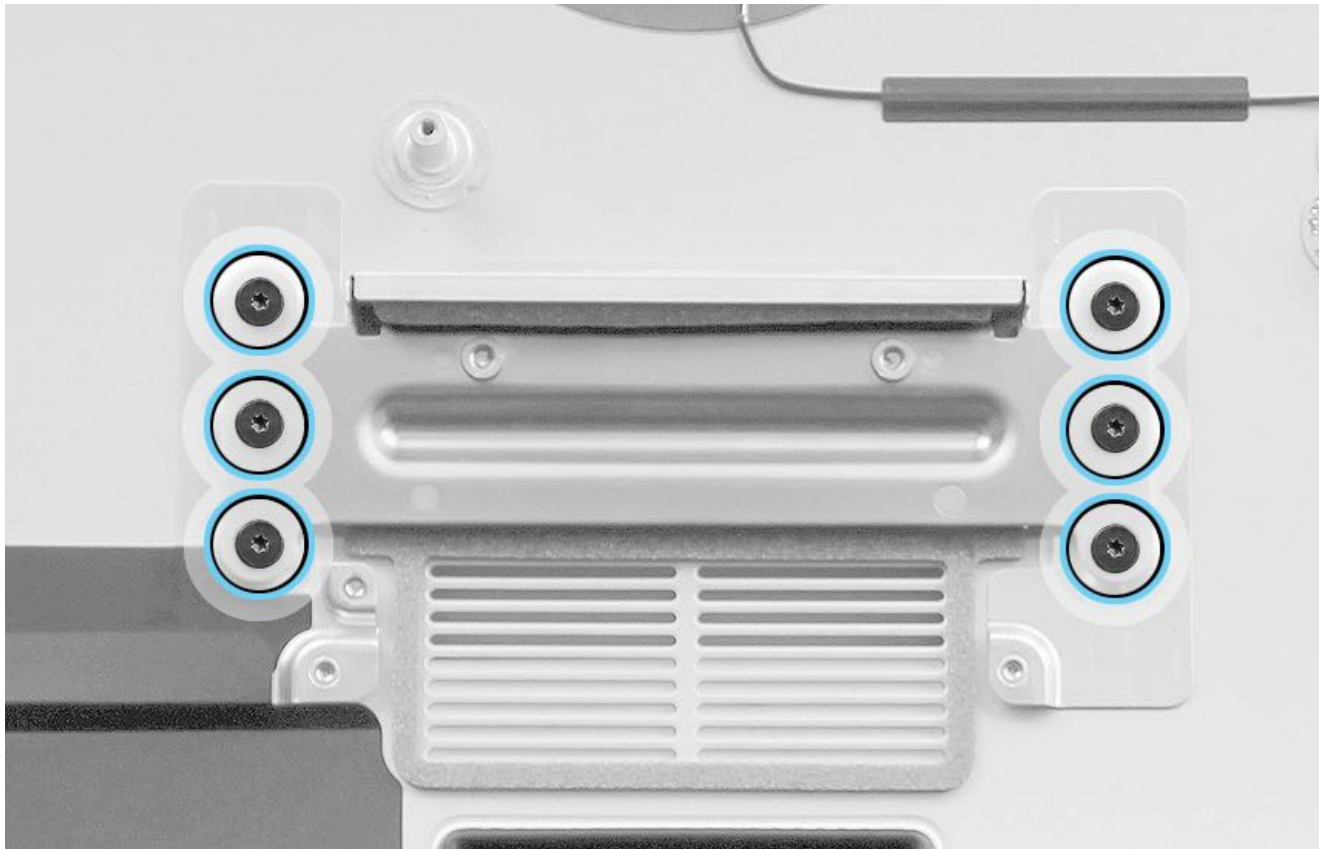
1. Place the iMac on the LCD service support stand with the VESA mount adapter facing you.
2. Remove two pentalobe screws from the VESA mount adapter.
3. Lift the VESA mount adapter off of the VESA tongue.



4. Pull the VESA tongue off of the rear housing.  
**Note:** The computer serial number is on the underside of the VESA tongue.



1. Place the rear housing on the LCD service support stand with the VESA mechanism plate facing you.
2. Remove six T10 screws.  
**Note:** There are four T10 screws for the iMac (Retina 4K, 21.5-inch, 2019).
3. Lift the VESA mechanism plate off of the rear housing.



## VESA Rear Housing

With all modules removed, the rear housing is the remaining part.

VESA rear housing:

- 923-01616: iMac (Retina 4K, 21.5-inch, 2019)
- 923-01667: iMac (Retina 5K, 27-inch, 2019)
- 923-04247: iMac (Retina 5K, 27-inch, 2020)

A VESA rear housing includes the following parts, which are **not** available separately:

- AC inlet
- audio input/output cable
- chin microphone flex cable (2019 only)
- dual chin microphone flex cable (2020 only)
- power button and cable
- Wi-Fi antenna in silver circle behind Apple logo
- wireless antenna insulators

A VESA rear housing includes the parts listed below, which are available separately. For additional part information, refer to the exploded view and screw chart of the model you are repairing.

- [Exploded View and Screw Chart for iMac \(Retina 4K, 21.5-inch, 2019\)](#)
- [Exploded View and Screw Chart for iMac \(Retina 5K, 27-inch, 2019\)](#)
- [Exploded View and Screw Chart for iMac \(Retina 5K, 27-inch, 2020\)](#)
- Chin strap and screws
- Memory door
- Memory door lock mechanism and screws
- VESA mechanism plate screws
- T25 standoff screws (vary by model)

## Steps For Reassembly

## VESA Tongue and VESA Mount Adapter

1. Insert the VESA tongue into the opening on the rear housing.



2. Align the screws holes on the VESA mount adapter with the screw holes on the VESA tongue.
3. Install two pentalobe screws.
  - VESA pentalobe: 923-0418



## VESA Mechanism Plate

1. Position the mechanism plate in the rear housing.
2. Reinstall the six T10 screws.
  - Note:** There are four T10 screws for the iMac (Retina 4K, 21.5-inch, 2019).
  - T10: 923-0334



3. Follow the list of required removal procedures in reverse order to complete the repair.

## VESA Rear Housing

1. Reinstall the VESA Mechanism Plate.
2. Reinstall the VESA Tongue and VESA Mount Adapter.
3. Follow the list of required removal procedures in reverse order to complete the repair.

# System Configuration for Mac Computers with the Apple T2 Security Chip

## System Configuration for Mac Computers with the Apple T2 Security Chip

**Important:** If you replace the logic board or flash storage in the user's computer, ensure the data is backed up now. You can't recover data after you run the System Configuration suite.



A repair of a Mac computer with the Apple T2 Security Chip isn't complete until you successfully run the AST 2 System Configuration suite. Successfully running the AST 2 System Configuration suite ensures repair quality and compliance with regional communications regulations. Successfully running the AST 2 System Configuration suite also ensures that the Apple T2 Security Chip works, enabling hardware encryption, biometric authentication, and secure startup protection.

The System Configuration Suite optimizes performance and performs tests in the following ways:

- The System Configuration suite conducts tests that verify that you correctly replaced parts and correctly reconnected parts related to the Apple T2 Security Chip during the repair. The System Configuration suite conducts test for parts including the Touch ID sensor, ambient light sensor, Touch Bar, display, and camera.
- The System Configuration suite pairs the Touch ID sensor and Touch Bar to the logic board and updates their calibration values for performance optimization. If you replaced the logic board, the System Configuration suite writes the system serial number to the new logic board and reports it to Apple. Reporting the logic board serial number to Apple enables iCloud services including FaceTime, Messages, and Apple Pay, and assigns the wireless region.  
**Note:** To comply with regional communications regulations, the computer will display a flashing circle with a line through it (prohibitory symbol) until the System Configuration suite assigns the wireless region.
- The final step for all repairs is to update the Apple T2 Security Chip firmware to the most current version.

System Configuration is used to ensure key modules are properly calibrated and paired with the logic board after a repair. The chart below details when System Configuration is always required.

### When System Configuration Is Required

**Perform System Configuration after these part replacements:**



Computer Model by Year	Logic Board	Top Case	Display	Touch ID	Flash Storage	Lid Angle Sensor (LAS)
<b>2017</b>						
iMac Pro (2017)	•				•	
<b>2018</b>						
Mac mini (2018)	•					
MacBook Air (Retina, 13-inch, 2018)	•			•		
MacBook Pro (13-inch, 2018, Four Thunderbolt 3 Ports)	•	•	•	•		
MacBook Pro (15-inch, 2018)	•	•	•	•		
<b>2019</b>						
MacBook Air (Retina, 13-inch, 2019)	•		•	•		
MacBook Pro (13-inch, 2019, Two Thunderbolt 3 Ports)	•	•	•	•		
MacBook Pro (13-inch, 2019, Four Thunderbolt 3 Ports)	•	•	•	•		
MacBook Pro (15-inch, 2019)	•	•	•	•		
MacBook Pro (16-inch, 2019)	•	•	•	•		•
Mac Pro (2019) and Mac Pro (Rack, 2019)	•				•	
<b>2020</b>						
MacBook Air (Retina, 13-inch, 2020)	•		•	•		
MacBook Pro (13-inch, 2020, Two Thunderbolt 3 Ports)	•	•	•	•		
MacBook Pro (13-inch, 2020, Four Thunderbolt 3 Ports)	•	•	•	•		
iMac (Retina 5K, 27-inch, 2020)	•		•			

## Tools

- Power cord
  - USB-C Charge Cable (661-06670) or USB-C to USB-A Cable (923-00504)
- Important:** Don't use Thunderbolt 3 cables.



- A host computer with:
  - macOS Catalina 10.15 or later
  - [Mac Configuration Utility \(MCU\)](#)
  - [The Latest Apple Service Toolkit](#) (OP476)

**Note:** Do not use third-party web browsers on a host computer with MCU. Third-party web browsers may impact the performance of System Configuration when MCU and third-party web browsers are open at the same time. Remove any third-party web browsers and then restart the MCU host computer.

- Internet connection

## Before Starting an AST 2 Session

1. Add the parts you replaced to the repair.
2. Add the known good board (KGB) and known bad board (KBB) serial numbers to the repair.  
**Important:** If you incorrectly enter or don't save the the serial numbers in the repair system, the System Configuration suite won't be available.
3. Save the repair.

## Note:

- You must use upper case characters for letters in the logic board serial number. To ensure accuracy, it is recommended to scan the QR code on the logic board.
- Close the display after putting the computer into DFU mode.

## Steps

1. Start a diagnostic session on the AST 2 [Diagnostic Console](#).
  2. Plug in the user's computer and the host computer.
  3. Connect the user's computer to the host computer. If the host computer doesn't have a USB-C port, use a USB-C to USB-A cable. Don't use a USB-C to USB-A cable with a USB-C to USB Adapter.
- Important:** You must connect the USB-C cable to the correct port on the user's computer.

**Notebooks:** Use the USB-C port closest to the Caps Lock key.



**iMac Pro and iMac (Retina 5K, 27-inch, 2020):** Use the USB-C port closest to the Ethernet port.



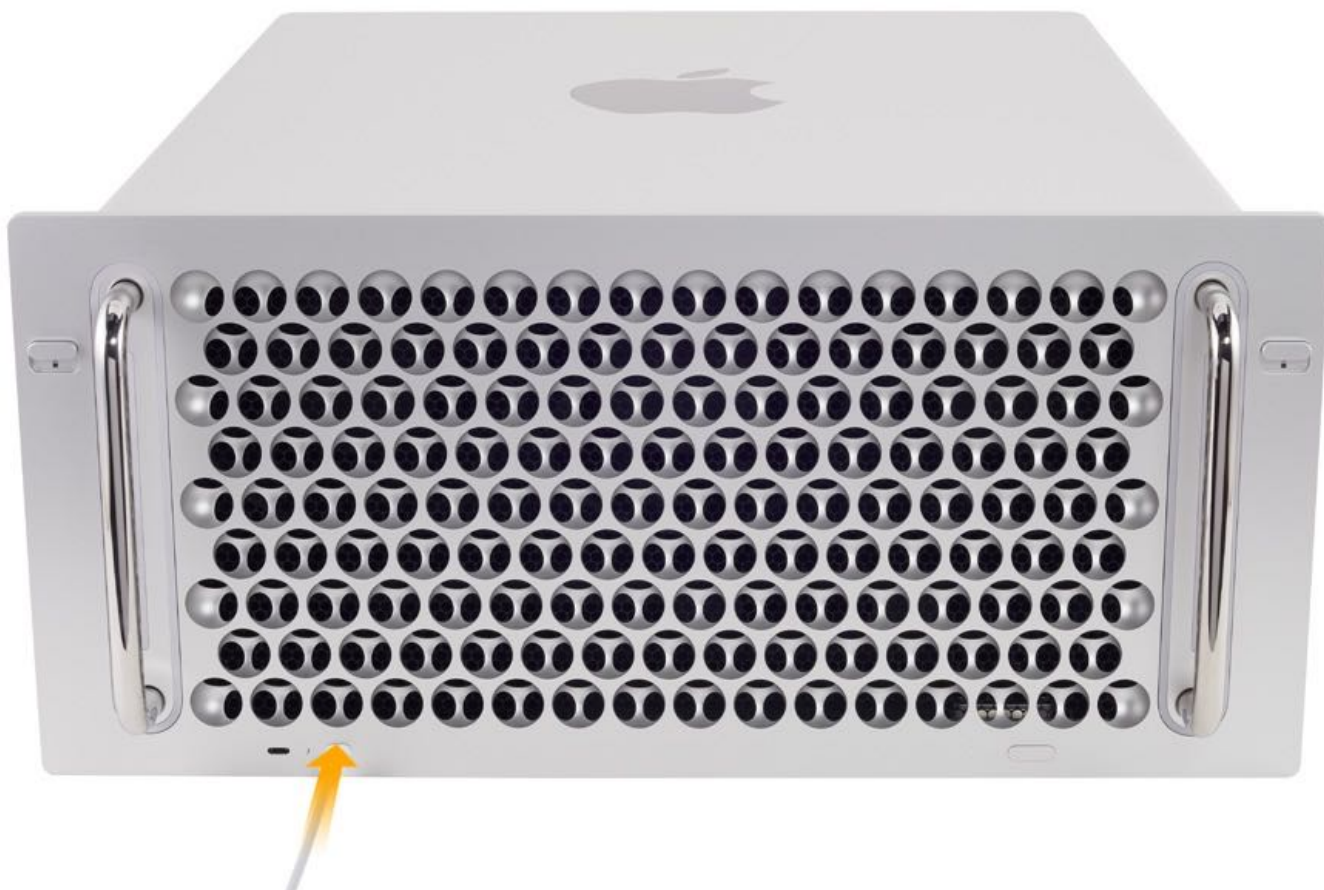
**Mac mini (2018):** Use the USB-C port closest to the HDMI port.



**Mac Pro (2019):** Use the outer USB-C port closest to the edge.



**Mac Pro (Rack, 2019):** Use the USB-C port closest to the power button.



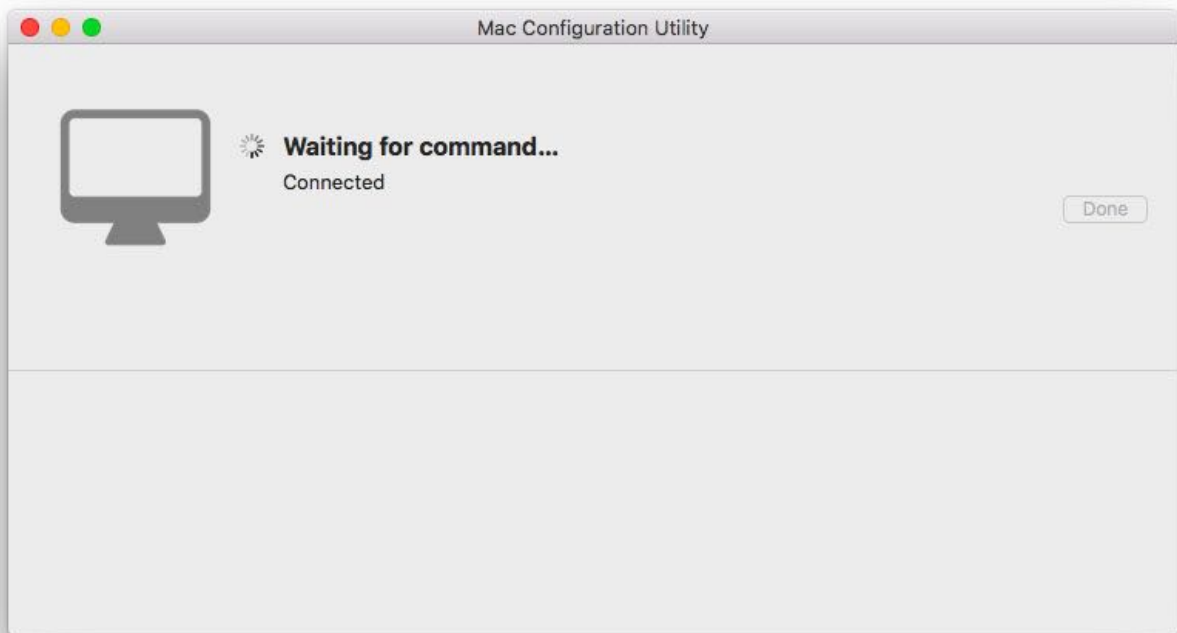


4. Turn on the host computer and connected it to the internet.

5. Start up the user's computer in [DFU mode](#) (TP1758). If DFU has been performed correctly, MCU will automatically launch and a dialog box will appear on the host computer screen.

- [For desktop computers](#) (SV402): Press and hold the power button while connecting the power cord and until the prompt appear in Mac Configuration Utility, which may take up to 10 seconds.
- [For notebooks](#) (SV401): Press and hold the power button, then press and hold Left Control-Left Option-Right Shift until you see the prompt appear in Mac Configuration Utility, which may take up to 10 seconds.

**Important:** For display repair and LAS repair in MacBook Pro (16-inch, 2019), look for a prompt to close the display. If you don't close the display when prompted, the System Configuration suite won't run properly and you will need to replace the LAS.



**Note:** If you haven't created a diagnostic session yet, a "Waiting for session..." message will appear.

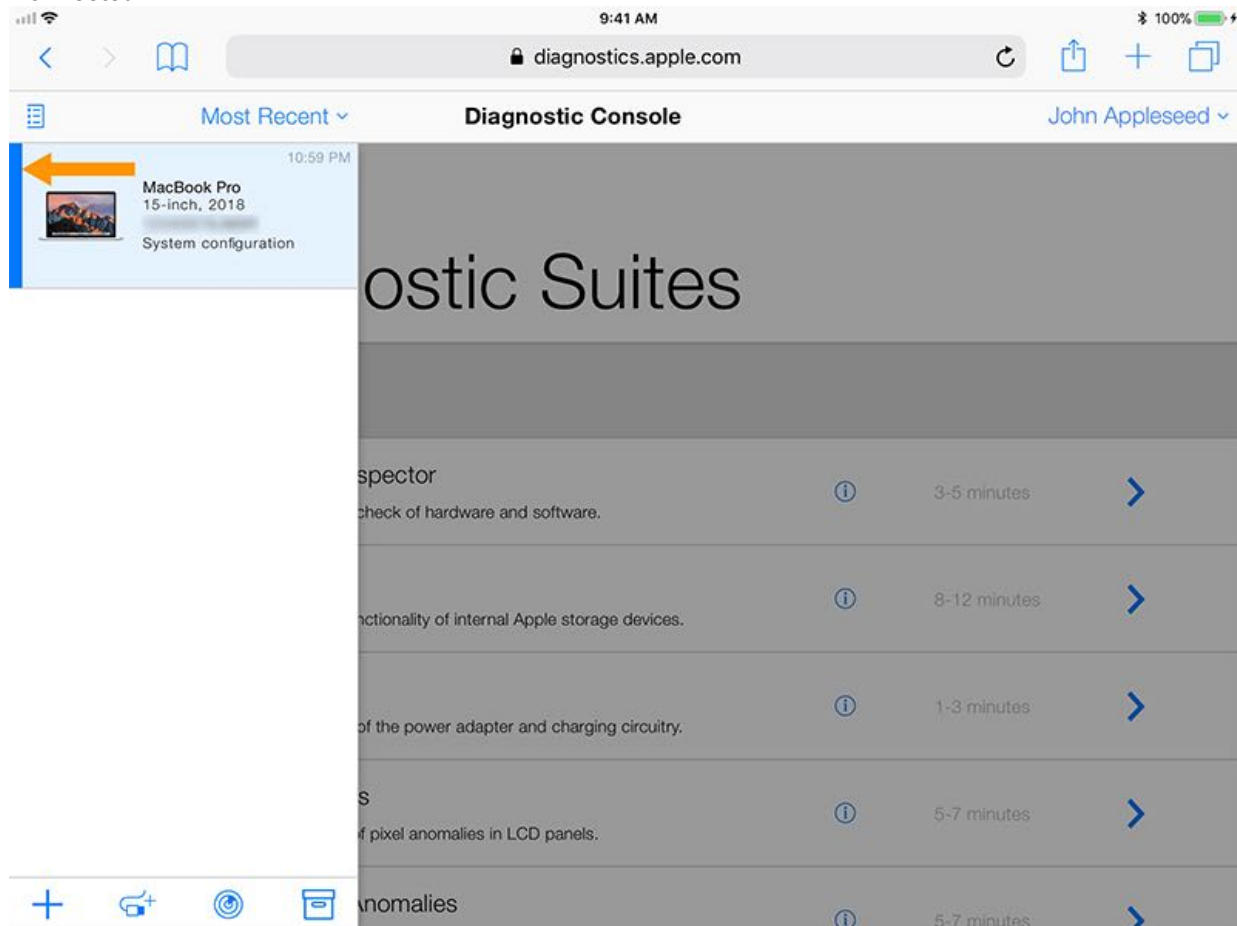




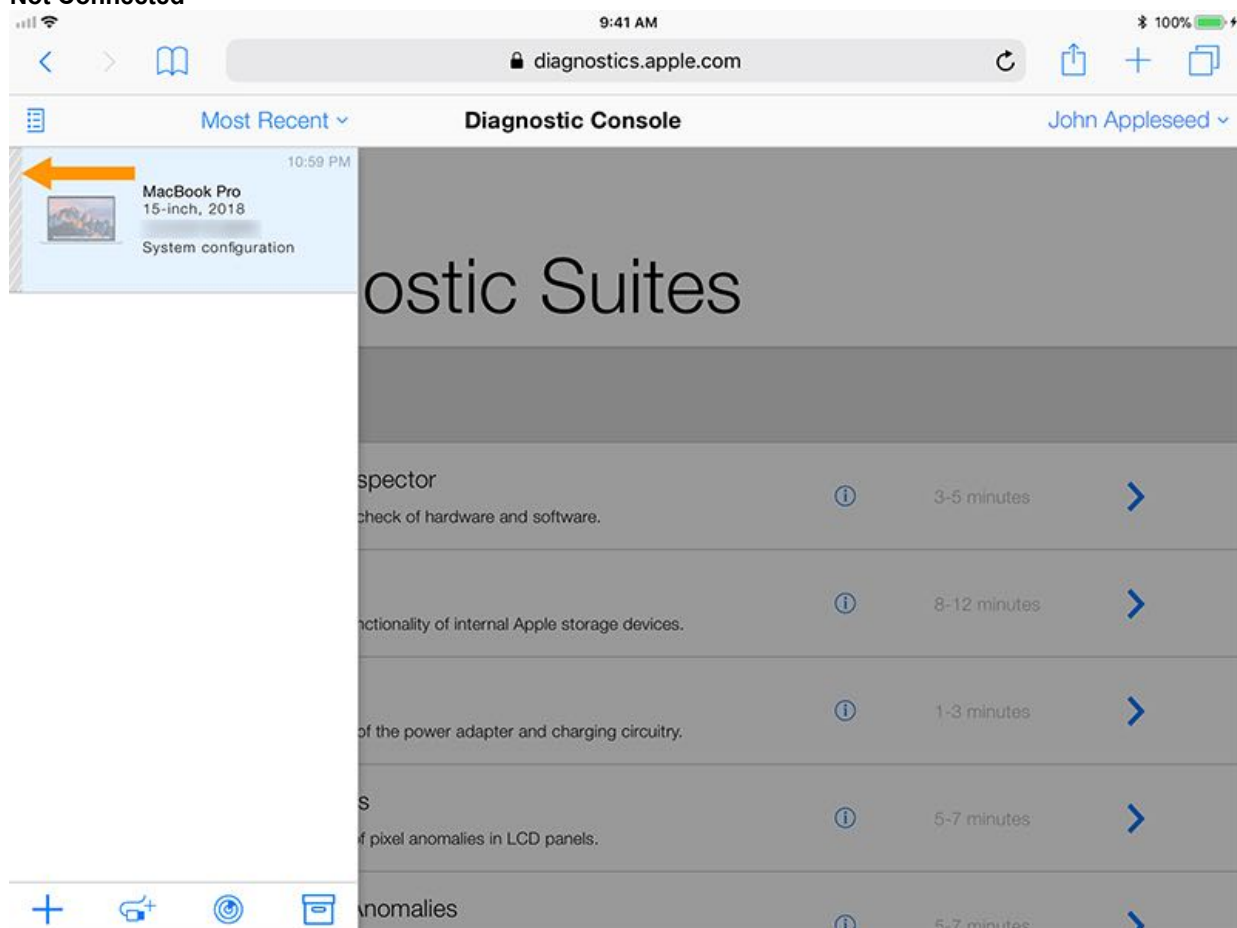
6. Confirm that a blue bar is next to the name and serial of the user's computer.

**Note:** If the computer doesn't appear on screen, you may have incorrectly entered the serial number or incorrectly saved the repair. Both the system serial number and the part serial numbers must be accurate to continue.

#### Connected



#### Not Connected



7. Choose the System Configuration suite from the Diagnostic Console. Eventually the Apple logo and a progress bar will appear, the user's computer will restart, and test results will appear in the Diagnostic Console.

9:41 AM


diagnostics.apple.com

100%

Diagnostic ConsoleJohn Appleseed


# Diagnostic Suites

POST-REPAIR





## Full System Diagnostic (EFI)

Performs comprehensive testing of hardware functionality and memory module integrity.




30-90 minutes






## Full System Diagnostic (OS)


Performs comprehensive testing of hardware and graphics functionality.



15-30 minutes




REPAIR COMPLETION





## System Configuration

Completes required configuration of applicable service parts and updates firmware after repair. This suite becomes available after service part serial numbers are saved in a repair. For more information refer to TP1657: System Configuration.




1-10 minutes






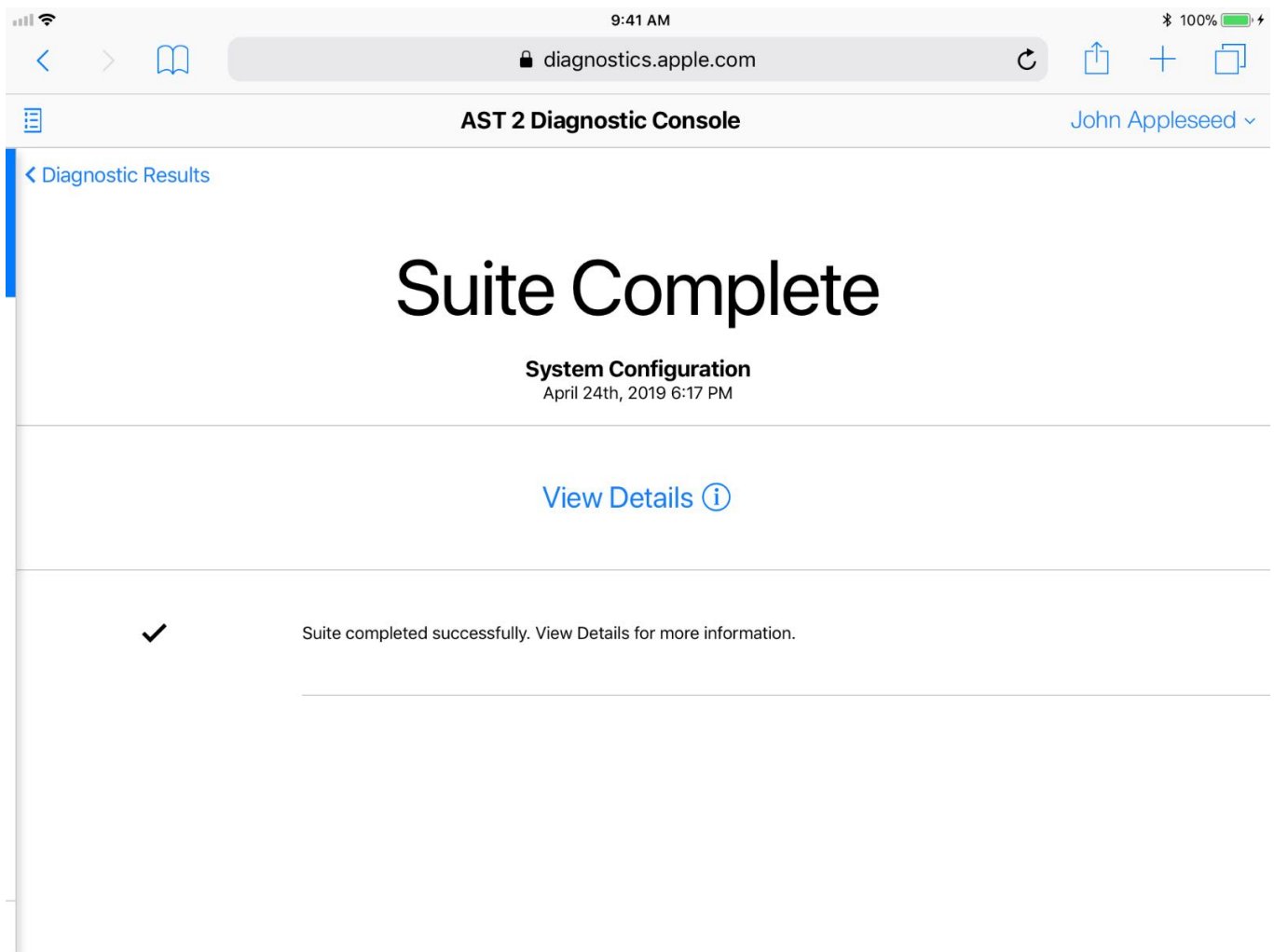
## Trackpad Calibration Check

Verifies calibration of the trackpad actuator and force sensor. This suite must be run each time the computer is opened and reassembled.



3-7 minutes





**Note:**

- While the System Configuration suite is running, the display on the user's computer will mostly stay blank.
- Firmware restoration will take about two minutes.

10. If no issues are found, restart the user's computer and run MRI as well as all applicable diagnostics.

- For notebooks, you must run the [Trackpad Calibration Check suite](#) any time you open the computer.

**Note:** For iMac Pro, macOS needs to be reinstalled. Shut down the computer and then restart in recovery mode to install the macOS from Internet Recovery.

11. If issues are found and a diagnostic test fails, follow the instructions on the Diagnostic Console and escalate to CSS.

**Troubleshooting Tips**

If the session does not activate (the gray bar doesn't turn blue), verify the following information:

1. The host computer is connected to the internet.
2. The user's computer is connected to power.
3. The user's computer is in [DFU mode](#).
4. You're using the correct port on the user's computer.
5. You're using the correct cable for connecting the host computer and the user's computer.
6. You correctly entered the serial number of the user's computer in the repair and in the Diagnostic Console.
7. You correctly added the parts to the repair.

If the System Configuration suite isn't available, perform the following steps:

1. Verify parts have been added to the repair.
2. Verify the KBB and KGB serial numbers are correct.
3. Verify the repair has been saved.
4. Archive and restart the diagnostic session.
5. Restart the host computer.
6. Open the user's computer and confirm that all parts are properly installed and all flex cables are securely connected.
7. If it has been more than 14 days since a logic board, top case, or display KGB *serial number* was added to the repair, escalate to CSS. If it has been more than 14 days since a Lid Angle Sensor or Touch ID *part* was added to the repair,

escalate to CSS.

If the diagnostic session is interrupted (the blue bar turns gray), perform the following steps:

1. Archive and restart the diagnostic session.
2. Check the network connection.
3. Restart the host computer.
4. Verify that the host computer isn't in sleep mode.
5. Open the user's computer and confirm that all parts are properly installed and all flex cables are securely connected.

# Diagnostics Required Based on Repair Module for Macs with the Apple T2 Security Chip

## AST 2 for Mac Reference Guide: Diagnostics Required Based on Repair Module for Macs with the Apple T2 Security Chip

When a Mac starts up to run diagnostics, it is in the EFI environment. Run all applicable diagnostic suites in the EFI environment first before switching to diagnostic suites that require restarting the Mac into a diagnostic OS. Diagnostic suite names are appended with (EFI) or (OS) to help identify which environment is needed to run a given suite.

### Diagnostic Categories

#### Triage:

Quick checks can be run with the customer to help confirm customer reported hardware issues. Run MRI anytime a computer will be checked in for repair.

- Display Anomalies
- Image Persistence
- Keyboard
- Lid Angle Sensor
- MRI (EFI)
- MRI (OS)
- Power Adapter
- Storage
- Touch ID
- Touch ID and Touch Bar
- Touch Bar Response
- Touch Bar Pixel Anomalies
- Trackpad

#### Repair:

Longer checks of hardware components to help isolate and reproduce customer reported issues. It is recommended to run these during the deep dive troubleshooting phase, prior to completing a repair.

- All module level tests

#### Repair Completion:

- System Configuration: For Macs with the Apple T2 Security Chip, the repair process is not complete for the replacement of certain parts until the AST 2 System Configuration suite has been run successfully. This step is required for Apple certified technicians to ensure repair quality and compliance with regional communications regulations. For more information refer to [System Configuration for Macs with the Apple T2 Security Chip](#).
- Trackpad Calibration Check (OS): Used to verify that the trackpad is responding as expected. Run Trackpad Calibration Check anytime the bottom case has been removed.

#### Post Repair Verification:

Tests used to validate a repair.

- MRI (EFI)
- Full System Diagnostic (EFI)
- Full System Diagnostic (OS)

After completing a Mac repair, consult the charts below to determine which diagnostic to run post-repair.

#### Portables

Module	Repair Completion	Post-Repair Verification
Audio Board/Audio Board Flex Assembly	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS) Audio (OS)
Audio Board Flex Cable	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS) Audio (OS)



Battery	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS)
BMU Flex Cable	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS)
Bottom Case	Trackpad Calibration Check (OS)	MRI (EFI)
Display Assembly	System Configuration Trackpad Calibration Check (OS)	MRI (EFI) Display Anomalies (EFI) Image Persistence (EFI) Full System Diagnostics (OS)
eDP Flex Cable	Trackpad Calibration Check (OS)	MRI (EFI) Display Anomalies (EFI) Image Persistence (EFI) Full System Diagnostics (OS)
Fans	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS)
Heat Sink	Trackpad Calibration Check (OS)	Full System Diagnostic (EFI) Full System Diagnostic (OS)
I/O Board	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS)
IPD Flex Cable	Trackpad Calibration Check (OS)	MRI (EFI) Keyboard (OS)
Lid Angle Sensor	System Configuration Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS) Lid Angle Sensor (OS)
Logic Board	System Configuration Trackpad Calibration Check (OS)	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Speakers	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS)
Top Case	Trackpad Calibration Check (OS)	Full System Diagnostic (EFI) Full System Diagnostic (OS) Keyboard (OS) Trackpad (OS) Touch Bar Response (OS) Touch Bar Pixel Anomalies (OS)

Top Case with Battery	System Configuration Trackpad Calibration Check (OS)	Full System Diagnostic (EFI) Full System Diagnostic (OS) Keyboard (OS) Trackpad (OS) Touch Bar Response (OS) Touch Bar Pixel Anomalies (OS)
Touch ID Board	System Configuration Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS) Touch ID (OS)
Trackpad	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS) Trackpad (OS)
Trackpad Flex Cable	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS) Trackpad (OS)
Vent/Antenna Module	Trackpad Calibration Check (OS)	MRI (EFI) Full System Diagnostic (OS)

## Desktops

Module	Repair Completion	Post-Repair Verification
Antenna Plate	-	MRI (EFI)
Antennas	-	MRI (EFI) Full System Diagnostic (OS)
Apple Afterburner	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Back I/O Card	-	MRI (EFI) Full System Diagnostic (OS)
Blower	-	MRI (EFI) Full System Diagnostic (OS)
Bottom Cover	-	MRI (EFI)
Camera Cable	-	MRI (EFI) Full System Diagnostic (OS)
Chin Strap	-	MRI (EFI) Full System Diagnostic (OS)
Coin Cell Battery	-	MRI (EFI) Full System Diagnostic (EFI)
CPU/CPU Thermal Module	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)

Display Panel	System Configuration iMac (Retina 5K, 27-inch, 2020)	MRI (EFI) Display Anomalies (EFI) Image Persistence (EFI) Full System Diagnostics (OS)
Dual Fan Assembly	-	MRI (EFI) Full System Diagnostic (OS)
eDP Cable	-	MRI (EFI) Display Anomalies (EFI) Image Persistence (EFI) Full System Diagnostics (OS)
Fans	-	MRI (EFI) Full System Diagnostic (OS)
Feet and Wheels	-	N/A
Flash Storage	System Configuration	MRI (EFI) Full System Diagnostic (OS)
Handles	-	N/A
Housing	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
I/O Wall	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Logic Board	System Configuration	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Mechanism	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Memory	-	Full System Diagnostic (EFI)
MPX Modules	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
PCIe Slots Frame	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Power Button with SIL	-	MRI (EFI)
Power Supply	-	MRI (EFI) Full System Diagnostic (OS)
Rear Housing	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Rear Mic Cable	-	MRI (EFI) Full System Diagnostic (OS)

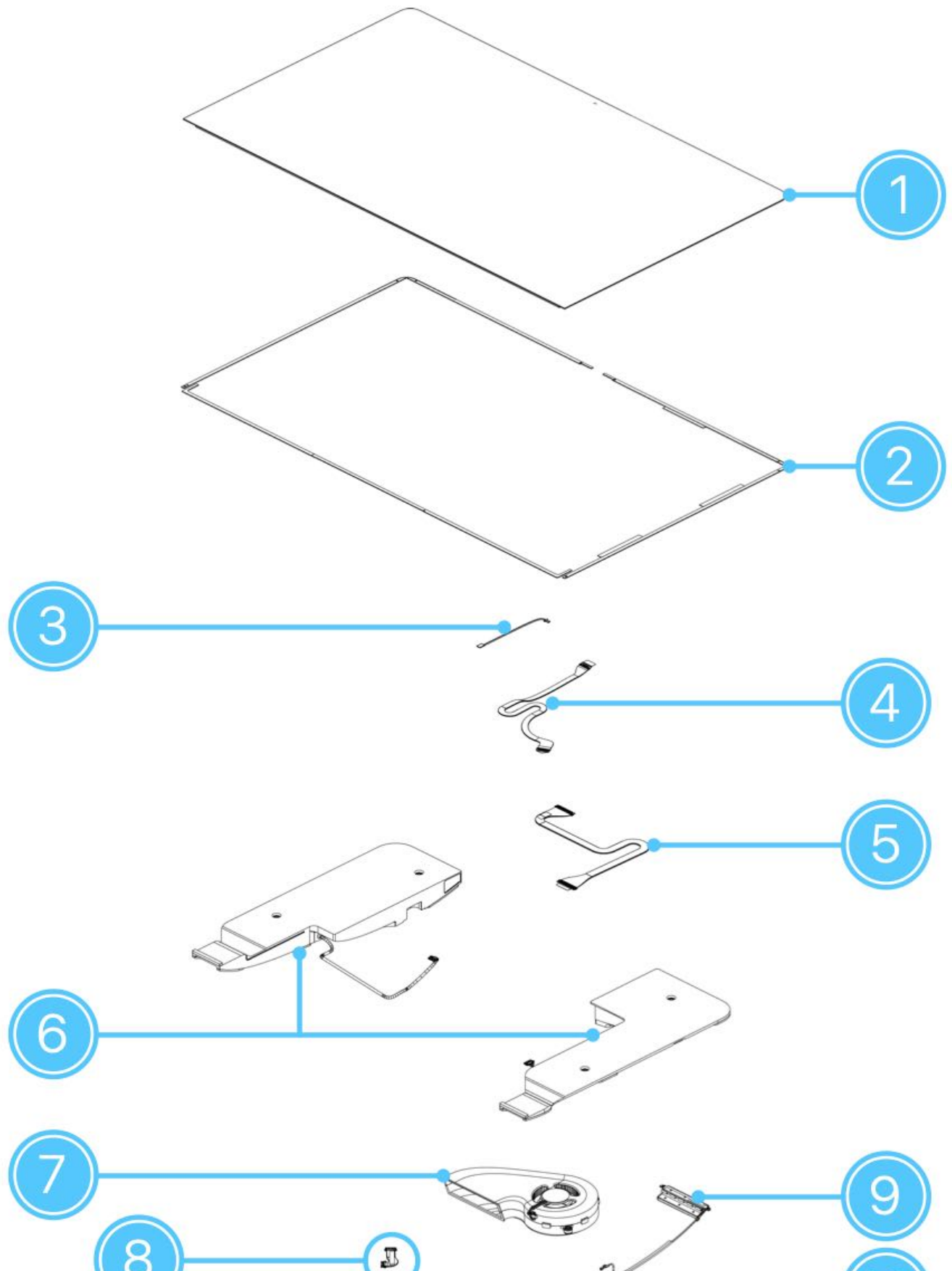
Space Frame	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Speakers	-	MRI (EFI) Full System Diagnostic (OS)
Stand	-	Full System Diagnostic (EFI) Full System Diagnostic (OS)
Top I/O Board	-	MRI (EFI) Full System Diagnostic (OS)
Top I/O Flex Cable	-	MRI (EFI) Full System Diagnostic (OS)
Vesa Mount Adapter	-	MRI (EFI)

# iMac (Retina 5K, 27-inch, 2020) Exploded View and Screw Chart

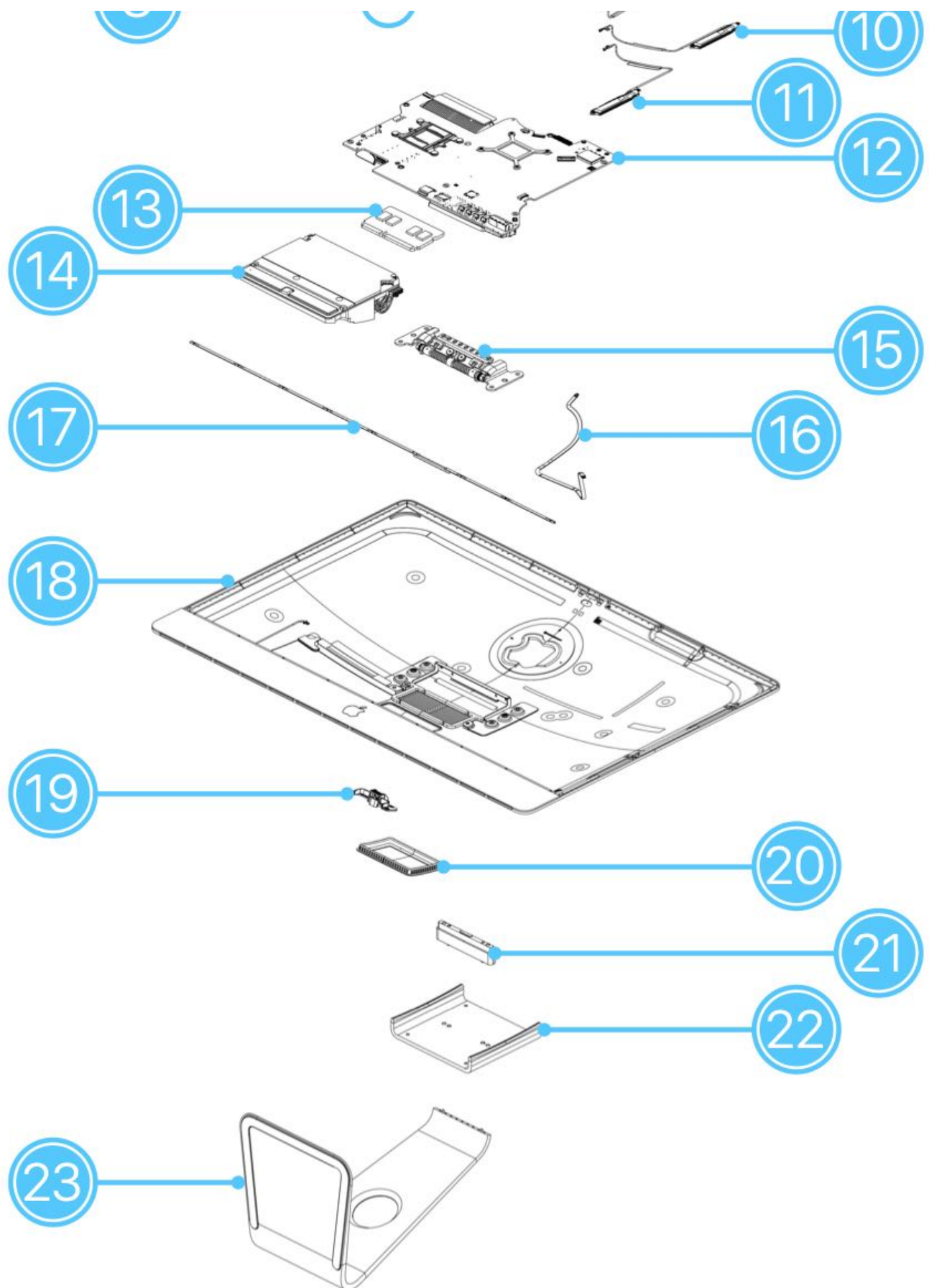
This article includes the following sections:

- [Exploded View](#)
- [Screw Chart](#)

## Exploded View for iMac (Retina 5K, 27-inch, 2020)







## 1. Display

- 661-16087, standard glass
- 661-16088, nano-texture glass

## 2. Display Adhesive - Very High Bond (VHB)

- 076-00490, Starter Kit
- 076-00491, Refill Kit

### **3. Display Thermal Sensor Cable**

- 923-0310

### **4. Camera Cable**

- 923-04229

### **5. Embedded DisplayPort (eDP) Cable**

- 923-03440

### **6. Left and Right Speakers (Pair)**

- 923-03072

### **7. Fan**

- 923-03071

### **8. Power Signal Cable**

- 923-0311

### **9. Bluetooth Antenna (top)**

- 923-00665

### **10. Wi-Fi Antenna (upper side)**

- 923-00667

### **11. Wi-Fi Antenna (lower side)**

- 923-00668

### **12. Logic Board**

#### **3.1GHz 6-core Intel Core i5, Radeon Pro 5300, 4GB GDDR6**

- 661-16008, 256GB, 1Gb Ethernet
- 661-16009, 256GB, 10Gb Ethernet

#### **3.3GHz 6-core Intel Core i5, Radeon Pro 5300, 4GB GDDR6**

- 661-16010, 512GB, 1Gb Ethernet
- 661-16012, 1TB, 1Gb Ethernet
- 661-16014, 2TB, 1Gb Ethernet
- 661-16011, 512GB, 10Gb Ethernet
- 661-16013, 1TB, 10Gb Ethernet
- 661-16015, 2TB, 10Gb Ethernet

#### **3.8GHz 8-core Intel Core i7, Radeon Pro 5500 XT, 8GB GDDR6**

- 661-16016, 512GB, 1Gb Ethernet
- 661-16018, 1TB, 1Gb Ethernet
- 661-16020, 2TB, 1Gb Ethernet
- 661-16022, 4TB, 1Gb Ethernet
- 661-16024, 8TB, 1Gb Ethernet
- 661-16017, 512GB, 10Gb Ethernet
- 661-16019, 1TB, 10Gb Ethernet
- 661-16021, 2TB, 10Gb Ethernet
- 661-16023, 4TB, 10Gb Ethernet
- 661-16025, 8TB, 10Gb Ethernet

#### **3.8GHz 8-core Intel Core i7, Radeon Pro 5700, 8GB GDDR6**

- 661-16026, 512GB, 1Gb Ethernet
- 661-16028, 1TB, 1Gb Ethernet

- 661-16030, 2TB, 1Gb Ethernet
- 661-16032, 4TB, 1Gb Ethernet
- 661-16034, 8TB, 1Gb Ethernet
- 661-16027, 512GB, 10Gb Ethernet
- 661-16029, 1TB, 10Gb Ethernet
- 661-16031, 2TB, 10Gb Ethernet
- 661-16033, 4TB, 10Gb Ethernet
- 661-16035, 8TB, 10Gb Ethernet

#### **3.8GHz 8-core Intel Core i7, Radeon Pro 5700 XT, 16GB GDDR6**

- 661-16036, 512GB, 1Gb Ethernet
- 661-16038, 1TB, 1Gb Ethernet
- 661-16040, 2TB, 1Gb Ethernet
- 661-16042, 4TB, 1Gb Ethernet
- 661-16044, 8TB, 1Gb Ethernet
- 661-16037, 512GB, 10Gb Ethernet
- 661-16039, 1TB, 10Gb Ethernet
- 661-16041, 2TB, 10Gb Ethernet
- 661-16043, 4TB, 10Gb Ethernet
- 661-16045, 8TB, 10Gb Ethernet

#### **3.7GHz 10-core Intel Core i9, Radeon Pro 5300, 4GB GDDR6**

- 661-16046, 512GB, 1Gb Ethernet
- 661-16048, 1TB, 1Gb Ethernet
- 661-16050, 2TB, 1Gb Ethernet
- 661-16047, 512GB, 10Gb Ethernet
- 661-16049, 1TB, 10Gb Ethernet
- 661-16051, 2TB, 10Gb Ethernet

#### **3.7GHz 10-core Intel Core i9, Radeon Pro 5500 XT, 8GB GDDR6**

- 661-16052, 512GB, 1Gb Ethernet
- 661-16054, 1TB, 1Gb Ethernet
- 661-16056, 2TB, 1Gb Ethernet
- 661-16058, 4TB, 1Gb Ethernet
- 661-16060, 8TB, 1Gb Ethernet
- 661-16053, 512GB, 10Gb Ethernet
- 661-16055, 1TB, 10Gb Ethernet
- 661-16057, 2TB, 10Gb Ethernet
- 661-16059, 4TB, 10Gb Ethernet
- 661-16061, 8TB, 10Gb Ethernet

#### **3.7GHz 10-core Intel Core i9, Radeon Pro 5700, 8GB GDDR6**

- 661-16062, 512GB, 1Gb Ethernet
- 661-16064, 1TB, 1Gb Ethernet
- 661-16066, 2TB, 1Gb Ethernet
- 661-16068, 4TB, 1Gb Ethernet
- 661-16070, 8TB, 1Gb Ethernet
- 661-16063, 512GB, 10Gb Ethernet
- 661-16065, 1TB, 10Gb Ethernet
- 661-16067, 2TB, 10Gb Ethernet
- 661-16069, 4TB, 10Gb Ethernet
- 661-16071, 8TB, 10Gb Ethernet

#### **3.7GHz 10-core Intel Core i9, Radeon Pro 5700 XT, 16GB GDDR6**

- 661-16072, 512GB, 1Gb Ethernet
- 661-16074, 1TB, 1Gb Ethernet
- 661-16076, 2TB, 1Gb Ethernet
- 661-16078, 4TB, 1Gb Ethernet
- 661-16080, 8TB, 1Gb Ethernet
- 661-16073, 512GB, 10Gb Ethernet
- 661-16075, 1TB, 10Gb Ethernet

- 661-16077, 2TB, 10Gb Ethernet
- 661-16079, 4TB, 10Gb Ethernet
- 661-16081, 8TB, 10Gb Ethernet

### 13. Memory

- 661-16082, 4GB, DDR4, 2666MHz
- 661-16083, 8GB, DDR4, 2666MHz
- 661-16084, 16GB, DDR4, 2666MHz
- 661-16085, 32GB, DDR4, 2666MHz

### 14. Power Supply, 300W

- 661-12714

### 15. Mechanism

- 923-03066

### 16. Rear Microphone Cable

- 923-04723

### 17. Chin Strap

- 923-04228

### 18. Rear Housing

- 923-04246
- 923-04247, VESA

### 19. Memory Door Lock Mechanism

- 923-01735

### 20. Memory Door

- 923-03069

### 21. VESA Tongue

- 923-04249

### 22. VESA Mount Bracket

- 923-0424

### 23. Stand

- 923-04248

### Not shown:






- Apple Polishing Cloth, 923-04724
- Antenna Cowling, 923-04252
- Power Cord, 923-0285
- Rear Housing Bracket, 923-03444
- VESA Mechanism Plate, 923-00657

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### Screw Chart for iMac (Retina 5K, 27-inch, 2020)

**Note:** Screws are not to scale.

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<b>923-0304</b> T4  <p>Bluetooth antenna (2) Upper Wi-Fi antenna (2) Lower Wi-Fi antenna (2)</p>	<b>923-0331</b> T8  <p>Logic board (4) Power supply (2)</p>	<b>923-0333</b> T10  <p>Right speaker (2) Left speaker (2)</p>
<b>923-0334</b> T10  <p>Mechanism (6)</p>	<b>923-0338</b> Phillips #00  <p>Chin strap (9)</p>	<b>923-0395</b> T10  <p>Heat sink (2)</p>
<b>923-0396</b> T8  <p>Power supply (2) Logic board (2)</p>	<b>923-0399</b> T25  <p>Power supply standoff (1)</p>	<b>923-0404</b> T5  <p>Memory door lock mechanism (4)</p>
<b>923-0418</b> Pentalobe  <p>VESA Mount (2)</p>	<b>923-0520</b> T25  <p>Logic Board standoff (1)</p>	<b>923-0521</b> T25  <p>Logic Board standoff (1) Use with rear housing bracket</p>
<b>923-00529</b> T8  <p>Stand (9)</p>	<b>923-00669</b> T10  <p>Fan (3)</p>	<b>923-00767</b> T8  <p>Logic board (1)</p>

**923-02294**  
T5



Antenna cowling (2)

**923-03311**  
T25



Fan superscrew (1)  
Use with rear housing bracket

**923-03434**  
T10



Rear housing bracket (1)  
Use with rear housing bracket